AVIATION WEEK

A McGRAW-HILL PUBLICATION

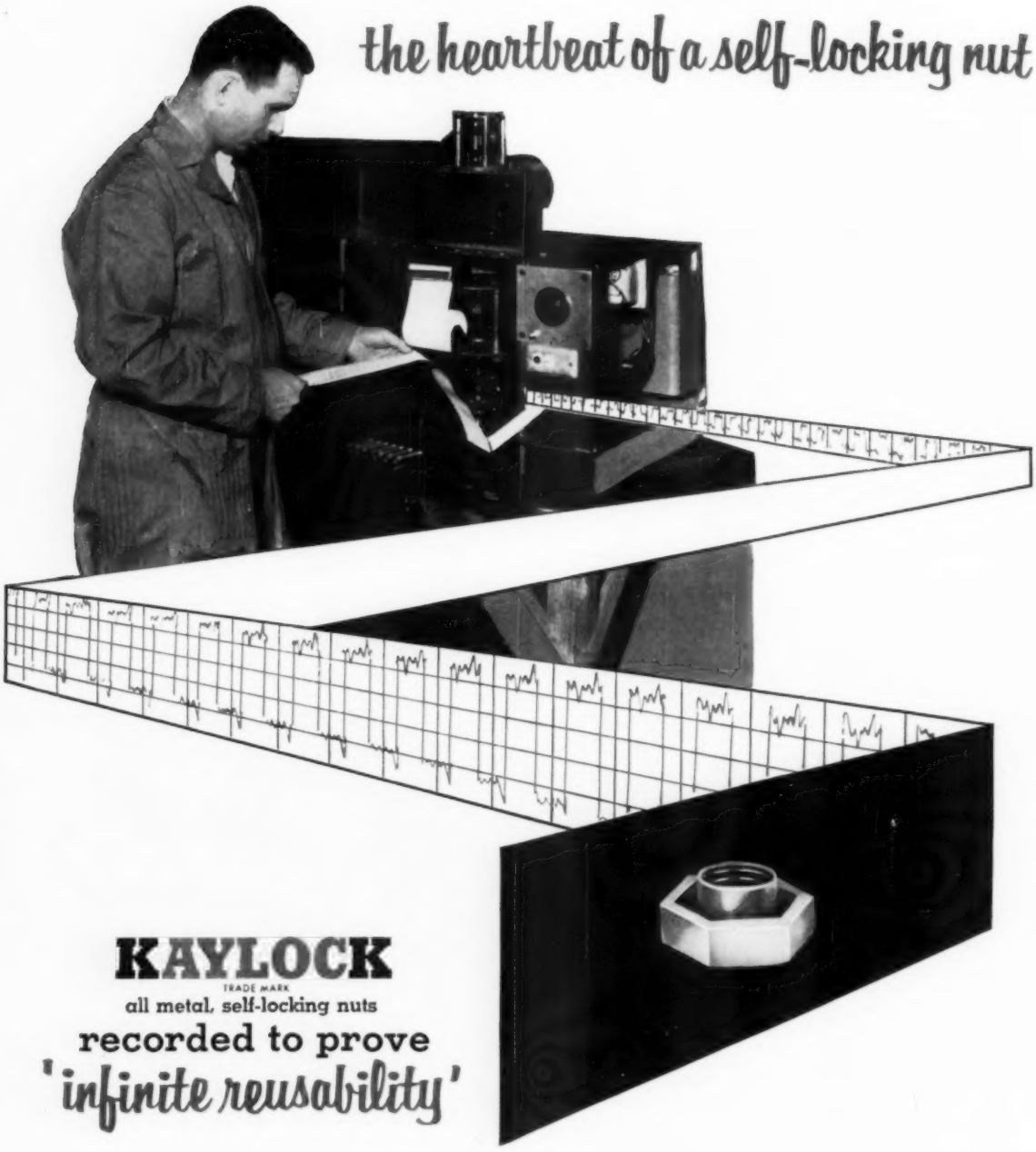
September 17, 1956 50 cents

Special Reports:

- IATA Meeting
- Canada Air Show

Helicopters Carry War to Algerian Rebels

the heartbeat of a self-locking nut



KAYLOCK
TRADE MARK
all metal, self-locking nuts

recorded to prove 'infinite reusability'

Kaylock Nuts withstand the rigors of the most accurate torque testing machine ever devised. We know. We designed and custom-built special automatic equipment which conducts self-locking torque tests; records the readings on continuous tapes; proves irrefutably the exceptional reusability of Kaylock Nuts.

KAYLOCK NUTS ARE PRECISION PRODUCTS AND CONFORM TO APPLICABLE AIR FORCE-NAVY SPECIFICATIONS AN-N-5 AND AN-N-10.

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Canadian Distributor: Abercorn Aero Limited, Montreal

IT DISHES OUT GUNFIRE—

and **can take an atomic blast**

Another Example Of Plastics Pioneering by Goodyear Aircraft Corporation

This parabolic radar reflector will soon direct antiaircraft firepower aboard a Navy vessel.

It weighs a mere 30 pounds—yet is able to withstand an atomic blast load of 22 tons.

How come it can take it as well as dish it out?

The key lies in integrated design—using a single-unit die-molded structural plastic to replace the host of detailed sheet-metal assemblies usually employed in such construction.

Developed by Goodyear Aircraft under contract with the Navy Bureau of Ordnance and Bell Telephone Laboratories, these plastic radar reflector dishes have proved they better their metal forerunners—*and more.*

They are lighter, stronger—eliminate complicated metal-work assembly—use two parts to replace many.

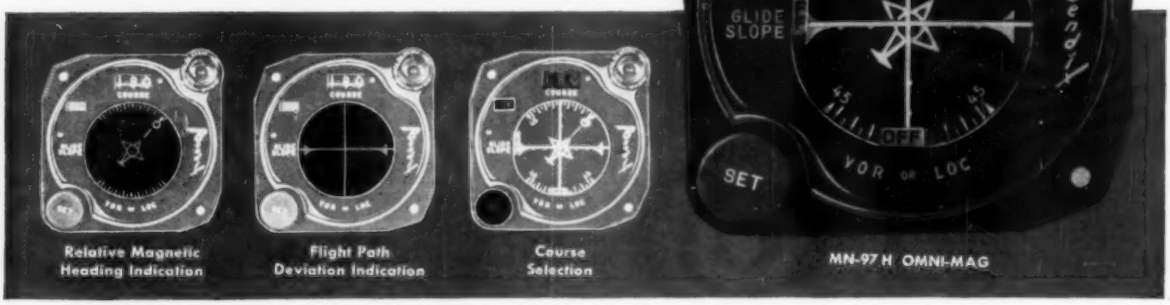
Already produced in diameters up to 72 inches, they are an excellent example of the plastic molding skills and facilities of Goodyear Aircraft Corporation.

Why not let such experience pave the way to overcoming difficult design and assembly problems facing you? By calling in Goodyear Aircraft, you will gain from this proved ability to fabricate such structures from metal, plastic and structural sandwich materials in combinations that pay off in strength-to-weight ratio, simplicity and exacting performance.

For information, write: Goodyear Aircraft Corporation. Plants in Akron, Ohio, and Litchfield Park, Arizona.

They're Doing Big Things at **GOODYEAR AIRCRAFT**

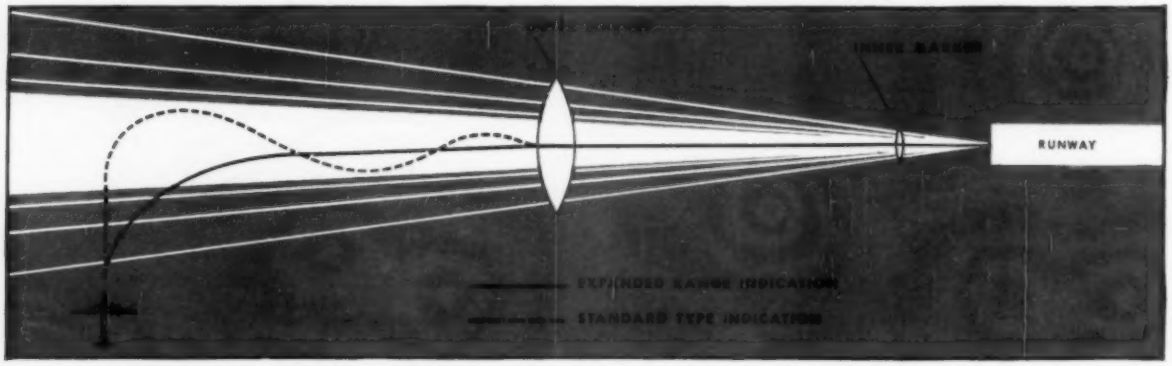
new Bendix expanded range OMNI-MAG



...combines 3 sources of VOR/ILS flight information on a single dial

Three vital VOR/ILS instruments in one... that's the Bendix* Omni-Mag Indicator. It performs all the functions of a Relative Magnetic Heading Indicator, a Flight Path Deviation Indicator, and an Omni-Bearing Selector ... and combines the information from each on a single, easy-to-read dial.

With this 3-in-1 "pictorial" feature, the Bendix Omni-Mag has found wide acceptance in the aviation industry. Twenty-nine airlines, more than 200 executive aircraft and hundreds of military aircraft are equipped with the Omni-Mag. Now, with the addition of an Expanded Range facility, the new MN-97H Omni-Mag takes its place as the lowest cost, most versatile, reliable and easiest to use VOR/ILS instrumentation system available.



...smooths out ILS approaches... eliminates need for bracketing

The Bendix Expanded Range Omni-Mag shows the pilot well in advance that he is approaching an ILS localizer beam. As a result, he can make a direct "close" on the beam, *without* the usual need for bracketing. By making possible more positive, quicker ILS approaches with considerably less maneuvering, the MN-97H promotes flight safety and helps reduce pilot fatigue.

For full details and specifications about this new Bendix navigation instrument, write Bendix Radio, Aviation Electronic Products, Baltimore 4, Maryland. *Reg. U.S. Pat. Off.

Bendix Radio

Bendix Radio Division • Bendix Aviation Corporation • Baltimore 4, Md.
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Export Sales & Service:
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Canadian Distributor: Aviation Electric, 200 Laurentian Blvd., Montreal, Que.

AVIATION CALENDAR

Sept. 17—International Air Transport Association, 12th annual general meeting, Edinburgh, Scotland.

Sept. 17-21—American Society for Testing Materials, Second Pacific National Meeting and Apparatus Exhibit, Hotel Statler, Los Angeles, Calif.

Sept. 17-21—Eleventh Annual Instrument-Automation Conference & Exhibit, sponsored by the Instrument Society of America, Coliseum, New York, N. Y.

Sept. 17-22—International Congress of Astronautics, sponsored by the International Astronautic Federation, Rome, Italy.

Sept. 18-20—Twenty-fourth USAF-Aircraft Industry Flying Safety Conference, sponsored by USAF Flight Safety Research, Santa Barbara, Calif.

Sept. 24-26—American Rocket Society, fall meeting, Hotel Statler, Buffalo, N. Y.

Sept. 24-28—1956 Trade Fair of the Atomic Industry, Navy Pier, Chicago, Ill.

Sept. 26—National Security Industrial Assn., Waldorf-Astoria, New York City.

Sept. 27-28—Fourth Michigan Aeronautics Conference, sponsored by Michigan Association of Airport Managers, Manistee, Mich.

Sept. 27-29—Southern California's Engineering Conference & Exhibit, sponsored by Engineers and Architects Assn., San Diego Chapter, Balboa Park, San Diego, Calif.

Oct. 1-3—12th Annual National Electronics Conference, sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, Illinois Institute of Technology and Illinois and Northwestern Universities, Hotel Sherman, Chicago, Ill.

Oct. 2-6—Society of Automotive Engineers, National Aeronautic Meeting, Aircraft Production Forum and Engineering Display, Hotel Statler, Los Angeles, Calif.

Oct. 3-5—1956 National Airports Conference, Univ. of Oklahoma, Norman, Okla.

Oct. 8-9—Aeronautical Communications Symposium, Hotel Utica, Utica, N. Y.

Oct. 25-26—Aircraft Electrical Society Annual Equipment Display, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 29-30—East Coast Conference on Aeronautical and Navigation Electronics, Sheraton-Belvedere Hotel, Baltimore, Md.

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What makes a wind tunnel *commercially* successful?

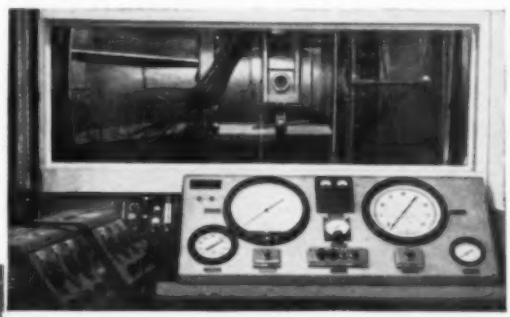
If the term "commercial success" could be applied to aeronautical test facilities, it would be on the basis of the data-dollar ratio. How much *valid* data is produced *per dollar of facility . . . per engineering hour.*

CompuDyne Control Systems, employing computor-dynamic techniques, are achieving increased output of *valid data* . . . by establishing and programming the test process.

CompuDyne Systems were developed for high-speed, dynamic control of transients . . . the basic control problem of test facilities. They attain steady-state control of test conditions . . . step, ramp or otherwise program variables . . . at higher speeds, with greater accuracy than ever before possible.

CompuDyne Control Systems encompass the full control loop . . . from sensor to final control element. They are pretested and performance-guaranteed on the basis of analog simulation of the control system and your process *in operation.* CompuDyne Control Systems are applicable to new installations or for improved performance of existing facilities.

Write or telephone for full information. *Informative new bulletin* entitled, "VALID DATA . . . *economically produced by dynamic process control*" will be sent to you upon request.



For Test Facilities . . . Typical CompuDyne Control Systems

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Vickers Servo Pump Systems

Provide rapid and accurate response to minute electrical or mechanical signals

The Vickers Servo Pump Unit shown at the right is a signal-controlled, variable delivery, positive displacement, reversible flow oil hydraulic pump. In combination with a rotary or linear hydraulic motor, it forms a signal-controlled hydraulic transmission for remote control operations and high-response servo systems.

The servo transmission may be considered as a power amplifier when viewed from the electrical signal input, of about five watts, to the mechanical power output of several thousand watts. Various sizes of transmissions have been built, having output capacity ratings from one to four hundred horsepower. The servo pump develops only that pressure required to move the load . . . which means reduced pressure over the greater part of the system life since peak loads occur only infrequently in the majority of systems. This greatly reduces power losses and minimizes heat rejection.

Any type of prime mover of sufficient capacity can be used to furnish the power input . . . electric motor, auxiliary drive pad on an airplane engine, air turbine, hydraulic motor, etc. Substantially constant speed is desirable.

Variable Pump Volume Controlled by Signal

Heart of the servo pump unit is the Vickers Variable Stroke Hydraulic Pump. This is usually a nine-cylinder pump housed in a pintle-mounted yoke. Varying the yoke angle varies piston stroke, hence, output volume from zero to maximum in either direction of flow. A stroking piston actuated by a pilot valve varies the yoke angle according to signal.

Low Control Power Requirement

Power for control purposes is low in a servo pump unit because metering valve action is confined to the volume-regulating system which is a low power level (100 to 300 psi) hydraulic system separate from the power transmission hydraulic circuit although a part of the pump unit. This volume-regulating system controls piston displacement and direction in the power pump which can operate at pressures up to 3000 or 4000 psi. Pressure drop across ports of a metering valve, with its inherent losses, is avoided in the power transmission system. Final power output from the pump is determined by the volume of flow which the volume-regulating system demands and by the actual resistance of the load . . . is not dependent upon pressure drop methods of control.

In a control system employing this servo pump, the variations in gain resulting from load change are negligible compared to those which may occur in a similar circuit controlled by a valve metering directly in the power line.

Constant Displacement Hydraulic Motor

Flow and pressure generated in the hydraulic pump are carried by tubing with no intermediate valving to the hydraulic motor or linear actuator. The fixed stroke hydraulic motor provides torque directly proportional to pressure and speed directly proportional to flow rate.

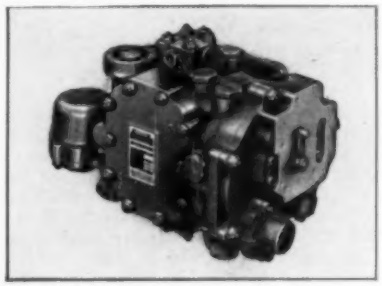
High Power-to-Weight Ratio

The servo pump unit and its associated hydraulic motor are designed for high power-to-weight ratio, high torque-to-inertia ratio, low inertia of rotating parts, and high resonant frequency.

Typical Example

High power-to-weight ratio—3.76 hp/lb (motor only)
High torque²-to-inertia ratio—3.5 x 10^7 lb-in./sec²
Low inertia of rotating parts— .052 lb-in.²
High resonant frequency— 20 cps (entire system)

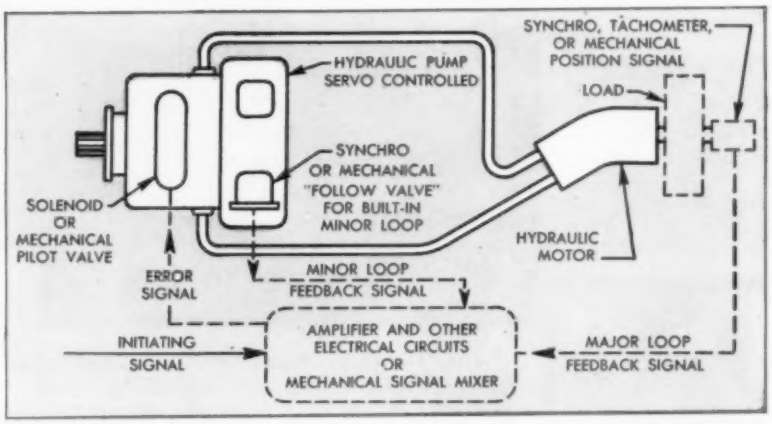
Other advantages are reliability and versatility of application. The smooth,



stepless speed changes and ability to hold position against any variation in load are additional reasons why this unit is a desirable resource which can solve many design problems.

Important among the applications of Vickers Servo Pump Units is extremely fast and accurate positioning of gun turrets on aircraft. Another is actuation of the exhaust nozzle for jet engines: here the servo pump's characteristic of providing at all times only sufficient power to meet the momentary demand minimizes the power loss and therefore the heat rejection. The greatly reduced average pressure level in this type of system prolongs the life and improves the reliability of all components.

For further information, ask for Bulletins SE-15 and SE-18 or get in touch with your nearest Vickers Aircraft Application Engineer. He can arrange for an engineering team to consider your problem and propose an optimum solution.


SYNCHRO, TACHOMETER, OR MECHANICAL POSITION SIGNAL
HYDRAUUC PUMP SERVO CONTROLLED
LOAD
SYNCHRO OR MECHANICAL "FOLLOW VALVE" FOR BUILT-IN MINOR LOOP
SOLENOID OR MECHANICAL PILOT VALVE
HYDRAULIC MOTOR
ERROR SIGNAL
MINOR LOOP FEEDBACK SIGNAL
INITIATING SIGNAL
AMPLIFIER AND OTHER ELECTRICAL CIRCUITS OR MECHANICAL SIGNAL MIXER
MAJOR LOOP FEEDBACK SIGNAL

SIMPLIFIED DIAGRAM illustrates a servo control system employing Vickers Servo Pump Unit and Constant Displacement Hydraulic Motor. This system accepts initiating signals (either electronic or mechanical, depending on type of system), compares them with feedback signals from load and (through controlled changes in direction and volume of fluid pumped to motor) corrects the load as required. For added accuracy and stability, a minor loop providing signals proportional to rate of flow may be added. This may either be built into the pump in the form of a mechanical "follow valve" which results in modulating the flow as a function of the net signal to the pump, or may be a synchro which feeds a signal proportional to flow rate into the amplifier. The controlled output may be either a function of the position or velocity of the load.

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World's largest Aluminum Forging

gives Navy's SeaMaster a lighter, stronger backbone

The Navy's new Martin SeaMaster is a multijet seaplane with performance comparable to land-based aircraft. Much of its high performance results from exceptional light weight.

One way the Navy saved weight was through the use of bigger forgings, such as the 3,800-pound giant, that form the backbone of wings and fuselage. Not only did this huge forging save the extra weight of smaller assemblies, it also made possible big savings in assembly time and machining cost.

It took months to construct the dies in Alcoa's shops, for these were the biggest closed forging dies ever made. Each finished set weighs more than 60 tons. It also took one of the world's two biggest forging presses, the 50,000-ton giant recently added to Alcoa's Cleveland facilities.

The forging itself was squeezed from a 4,200-pound billet of X7079 alloy developed by Alcoa® for higher strength, better ductility and superior heat-treatability in heavy sections.

While production of this large forging was a metalworking milestone, it also emphasizes the point that Alcoa has the facilities and technical knowledge required for solving any problem involving aluminum for aircraft. To learn more about these facilities and the tremendous depth of Alcoa's experience, write Aluminum Company of America, 1800-J Alcoa Building, Pittsburgh 19, Pa.

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This one-piece aluminum forging weighs 3,800 pounds. It is 13 feet long, 3 feet wide and 1 foot thick.

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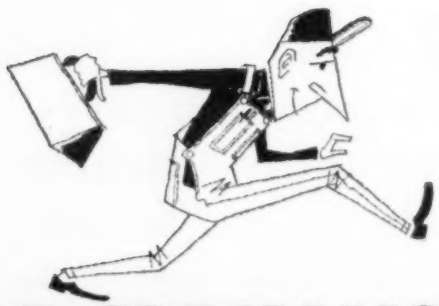

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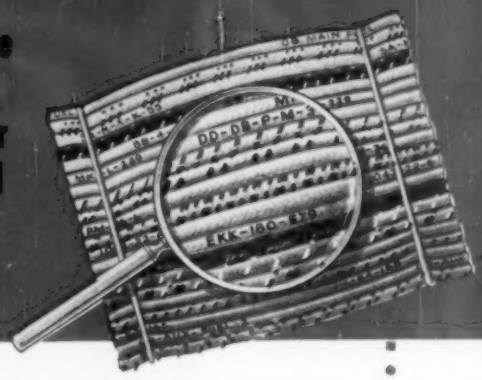
From entire standard, stamped, or color-coded Cable Systems



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Be Sure — Be Safe with WW400 . . . and in addition, ***Save Time — Save Weight — Save Money with WW500.*** The world's most rugged, heat-resistant and abrasion-resistant cables of its type. The silver-plated, copper heart of each is protected by impermeable, Teflon-treated glass and glass braid. With WW500, you save time, weight and money because tagging or "ringing out" is no longer necessary! Color-coding, through 10 solid colors and an unlimited number of color combinations, permits ***instant circuit identification anywhere it is used*** . . . or if you prefer to code with standard marking equipment, there is White WW500. WW400, colored "natural" brown, is for standard tag identification. Send for samples and Specification Chart "WW400-WW500".

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Type E and EE

WARRENITE Teflon-wrapped
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A complete assortment of strandings, dimensions, colors and color combinations — to fit every need. All three types possess superior dielectric, concentricity and resistance to water absorption; are unaffected by fungus. Where flexibility is important, these wires perform perfectly. Type E and EE wires have 600 and 1000 volt ratings respectively. Send for samples and Specification Chart "WTFL".

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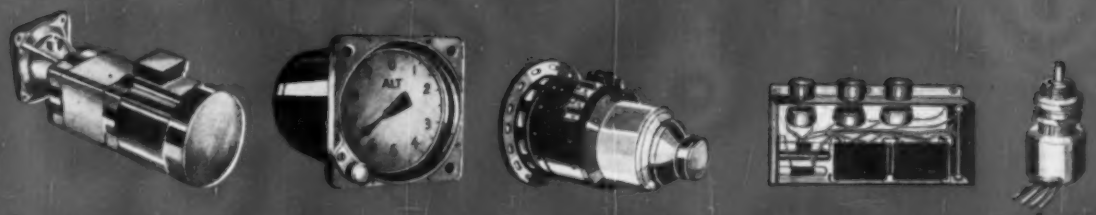

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— any gauge can be wound on own diameter

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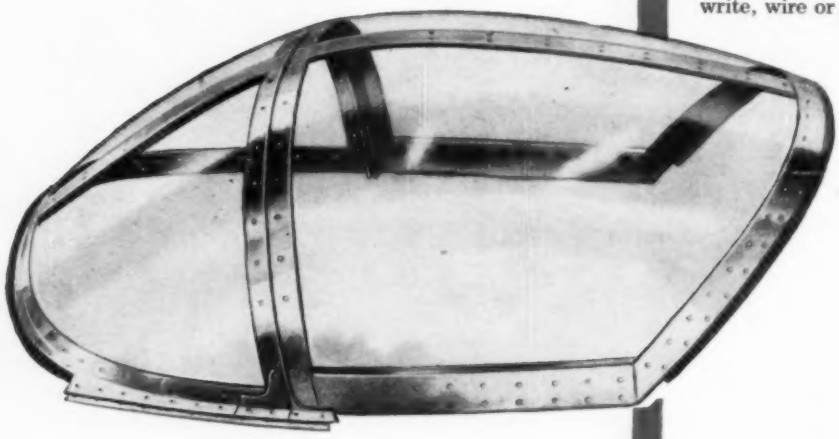

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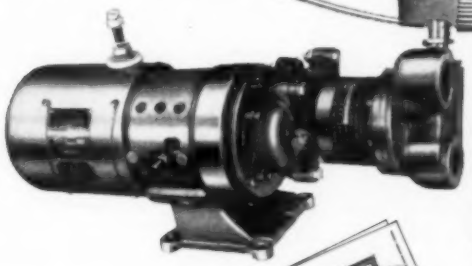
Making Props Behave

Proven *Quality* costs no more... *Specify* ADEL



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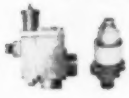

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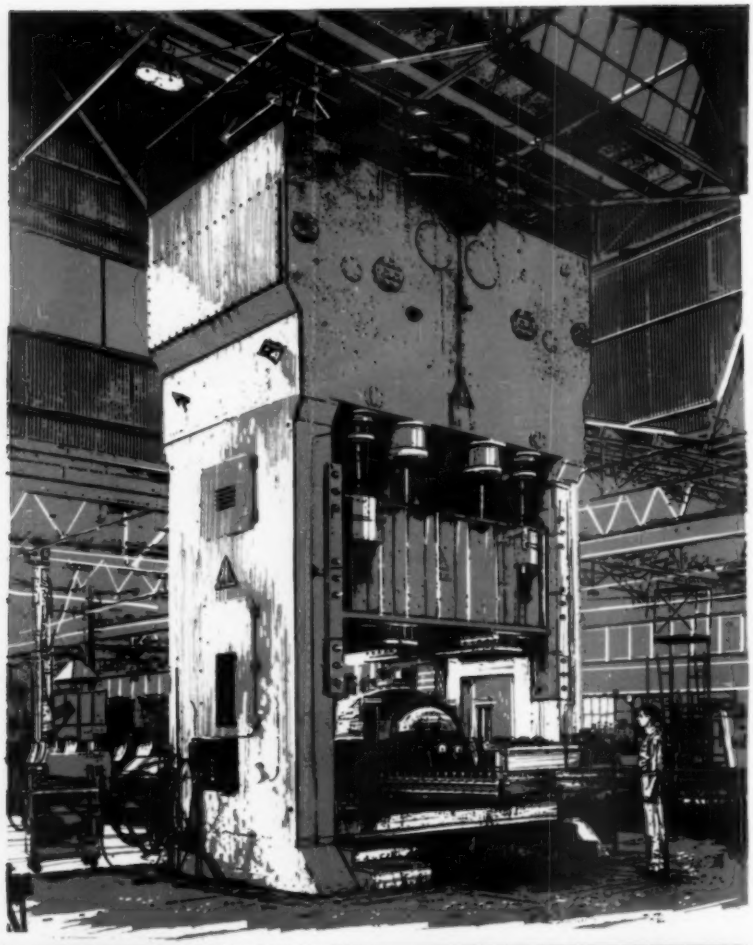

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For design and engineering know-how, for full production facilities look to Rohr to build more into the aircraft parts you need.

In addition to the Lockheed C-130 Hercules shown here, Rohr builds power packages for many other leading commercial and military planes which have made Rohr famous as the

WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POW-R-PAX FOR AIRPLANES

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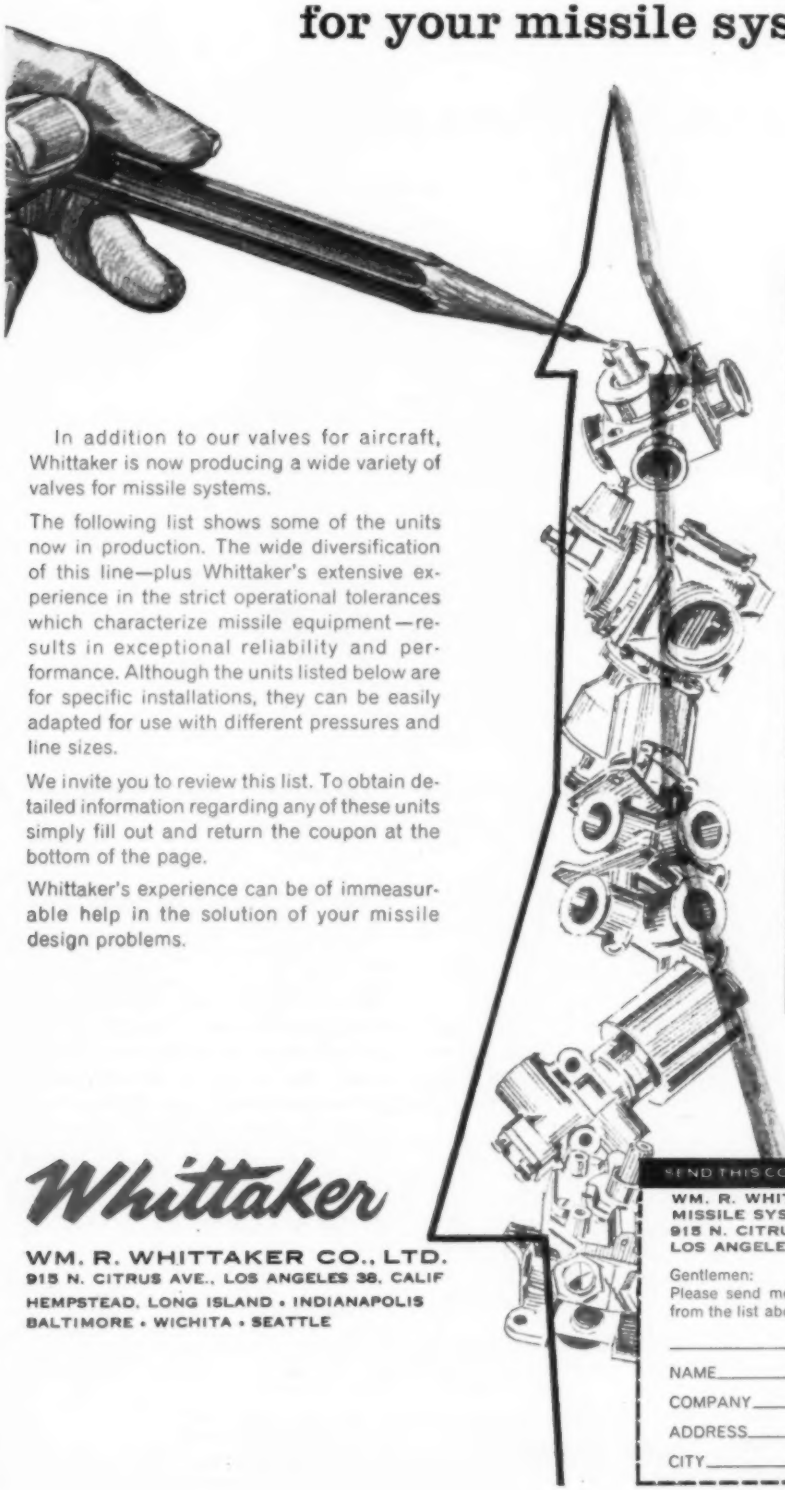

In addition to our valves for aircraft, Whittaker is now producing a wide variety of valves for missile systems.

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V	Aircraft Fuel	1-1/2"	Man. Oper. Gate Shut-Off
VI	Helium	2-3/4"	Pressure Relief Valve
VII	Helium	2-3/4"	Pressure Regulator Valve
VIII	Helium	1" & 2-1/2"	Pressure Regulator Valve
IX	Helium	2-1/2"	Pressure Relief Valve
X	Helium	3/4"	Shut-Off Valve, Normally Closed, Solenoid Pilot Oper.
XI	Helium	1/2"	Shut-Off Valve, Normally Closed, Solenoid Pilot Oper.
XII	Helium	3/8"	Pressure Relief Valve
XIII	Air	1/4"	5-Way, 4 Pos. Solenoid Act. Pop. Sol.
XIV	Hyd. MIL-O-5606	3/8"	Pressure Reducer
XV	Tex. Corvus Smoke Prod. Oil	3/8"	Solenoid Act. Hyd. Valve Shut-Off 150 PSI.
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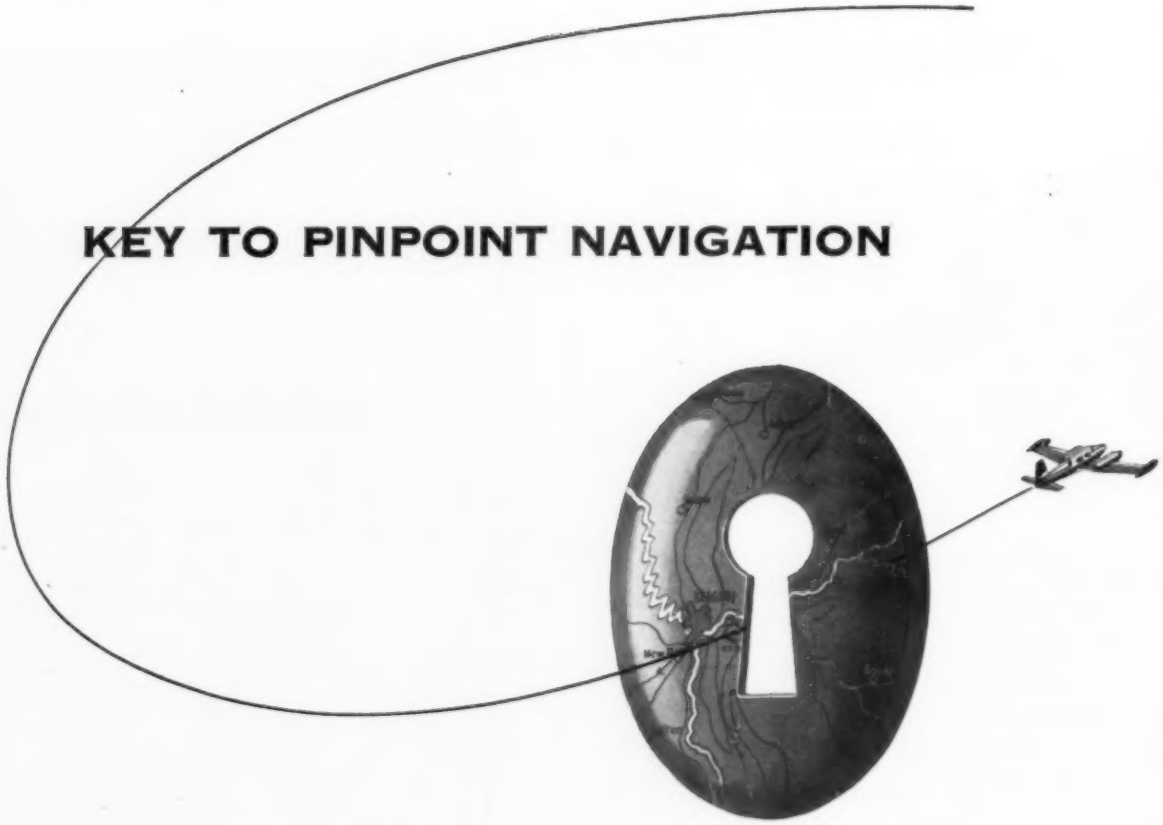

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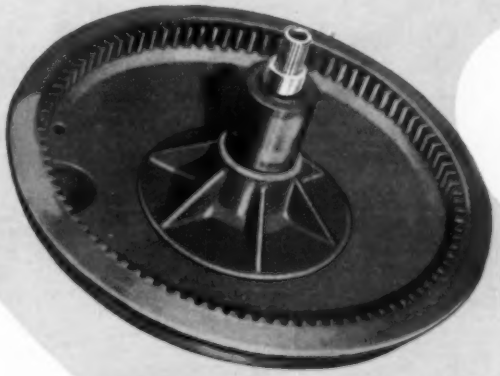

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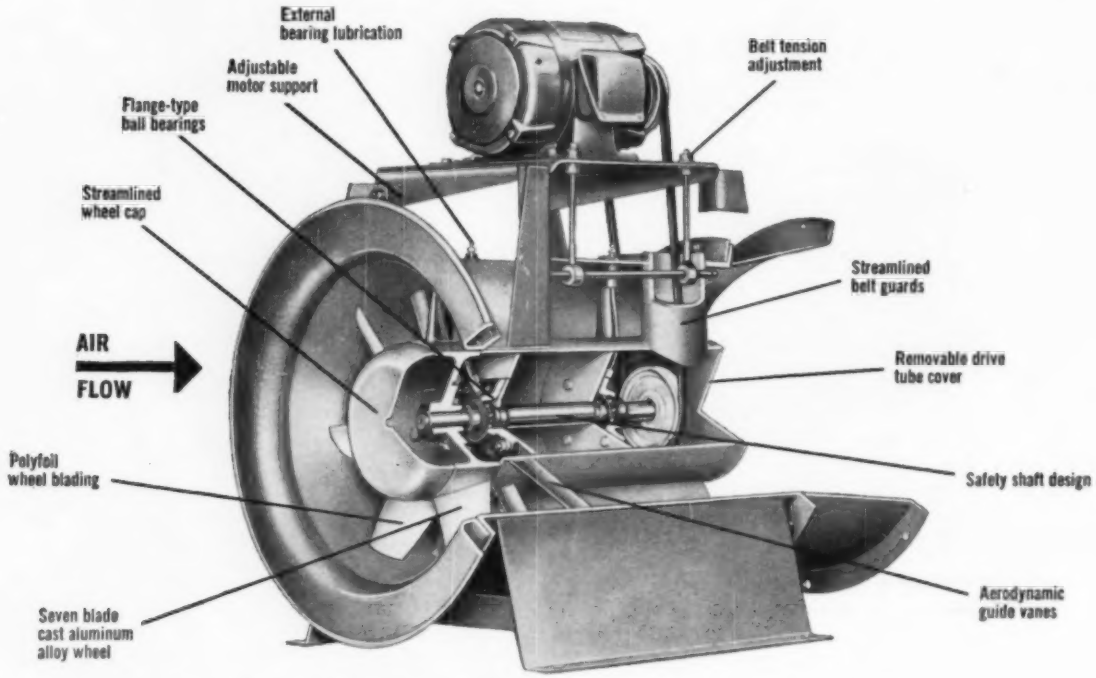

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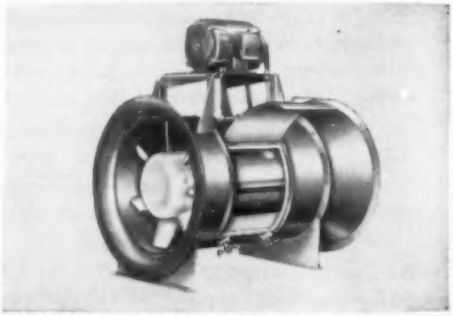

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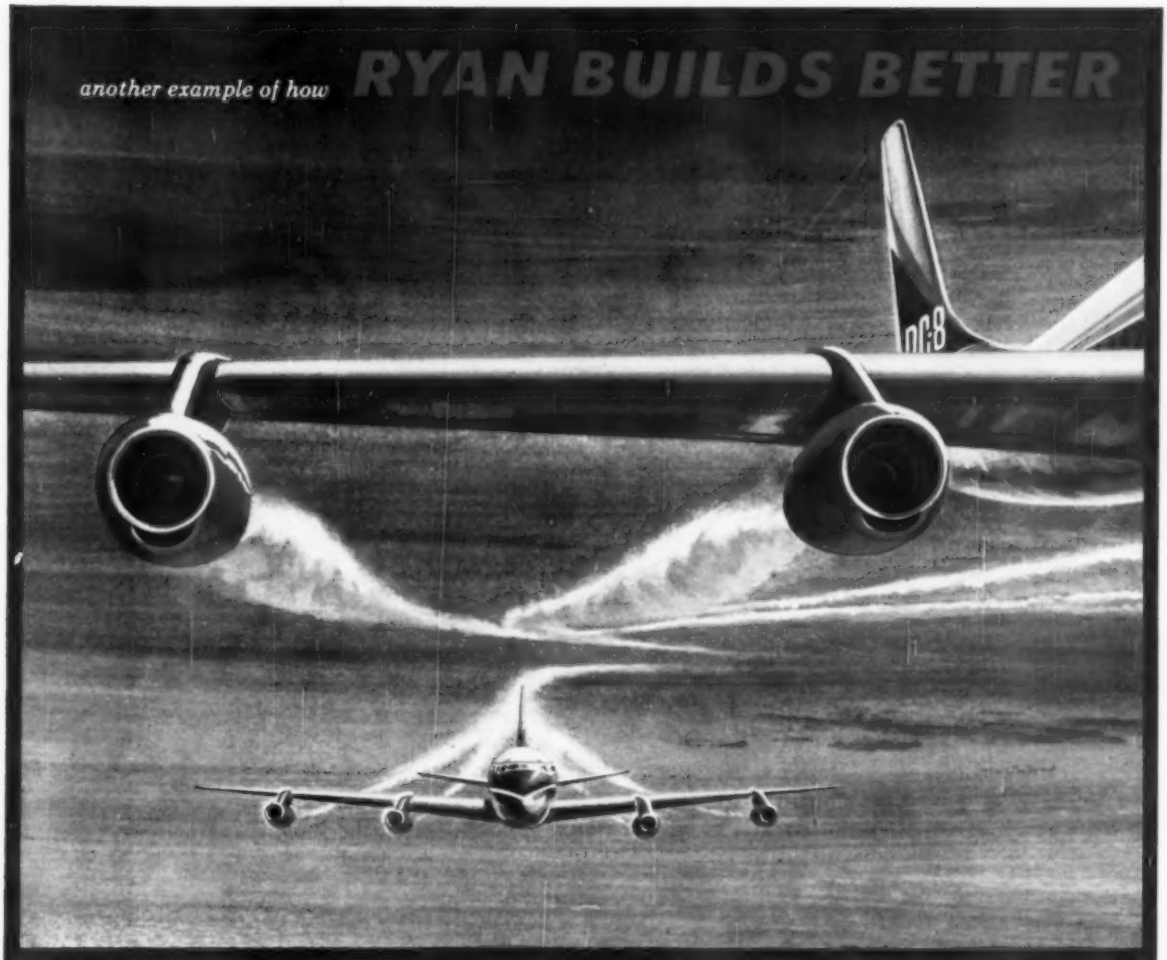

RYAN TO BUILD DC-8 JET PACKS AND PYLONS

Jet Packs. Ryan has been selected by the Douglas Aircraft Company to manufacture complete jet power packs and pylons for the new DC-8 commercial airliner. Substantial orders for these 550 mph Jetliners have been placed by 11 major airlines.

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Engineering. Ryan is devoting a substantial amount of effort to working with Douglas personnel in the engineering of the DC-8 jet packs and the supporting pylons. Ryan has extensive experience in the integration of power plants and airframe structures.

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SEPTEMBER 17, 1956

AVIATION WEEK

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COVER: Boeing's KC-135 Stratotanker in the foreground is making its maiden flight from Renton Municipal Airport at Seattle, Wash., Boeing 707 transport banks away in background. R. L. (Dix) Loesch, Boeing senior experimental test pilot, and A. M. (Tex) Johnston, chief of flight test, were at the controls of the KC-135 on the 1 hr. 19 min. flight. KC-135, in quantity production for SAC, is first jet tanker to come off production line.

Picture Credits:
97—Wide World; 116, 117—Burton Kemp.

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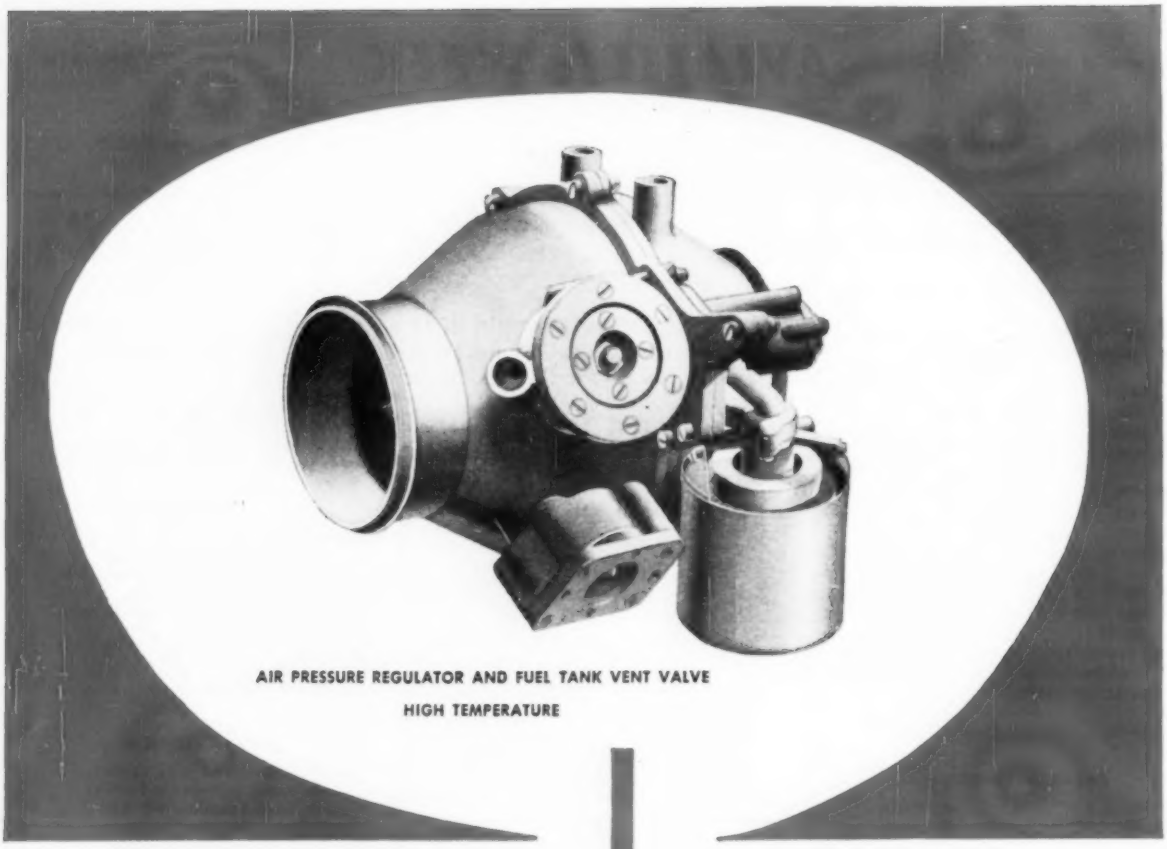

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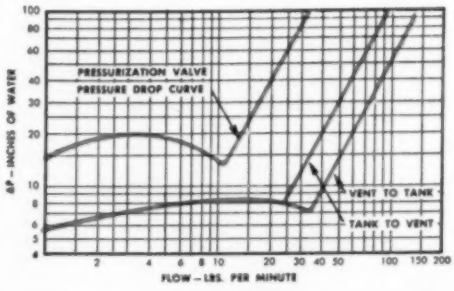

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International Mail Rate Problem

(Sir William Hildred has called the attention of the 12th Annual General Meeting of the International Air Transport Association to a grave matter that will face them within the next 12 months when the Universal Postal Union will hold its congress at Ottawa to consider setting international air-mail payments to airlines that carry foreign mail. This is a matter on which Sir William has been eloquent in the past and his words express the problem well.)

"Government delegates go to these congresses as plenipotentiaries, with power to sign a Postal Convention which thereby becomes a binding agreement between governments. These government delegates are postal officials and are therefore, in effect, the users of the air mail service. This is a very strange situation: The user of the service sets the rate by secret ballot without the transporter having any say in the matter at all. And you can't talk to a Postal Conference ten minutes without being told in tones of awe that 'congress is supreme.'

"There is only one thing for you to do. That is to see that the top officials of your governments—the prime ministers or, in certain cases, the ministers of finance fully appreciate the situation, so that they may instruct the post office people, if they see fit, to vote in the right sense when they get to the congress. This is something which each of you must do to enable us to accomplish our objective of not losing more revenue in performing this service for the public. If each of you says to himself, 'I find it a little difficult to speak to my government and I shall rely on the carrier sitting on my right and the carrier sitting on my left', then you may as well reconcile yourselves to a loss of many millions of dollars.

"Remember, we are not asking for an increase in rates. We are only asking that the present rates, already smashed down some years ago at the Brussels Congress, should not be further reduced. Most airlines have a thin profit margin or none; if air mail rates are to be cut still further, we shall be in a bad way.

"Such an act would only mean that many of the major airlines would require subsidizing by their governments; and that money would have to come out of the pockets of the taxpayers. And remember to tell your minister that it would be out of the pockets of the taxpayers of those countries which provide international air transport and would go largely into the coffers of the post offices of the countries which do not have major air networks. I hope some of the larger governments will make it clear that if there is an attempt at Ottawa further to cut the rates, there will be no signed Postal Convention.

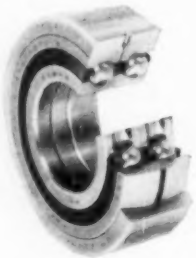
"Remember that, since Brussels when the rates were pulled down without consultation, the airlines have collectively decided to invest millions of dollars for the purchase of jets. This will increase the value of the main commodity we sell, namely speed, by 40%. That increment of value benefits the postal administrations absolutely by increasing their efficiency in the eyes of the public.

"Letters get there that much quicker; business, dividends, private relationships, contact with fellow men are all intensified and speeded up. It's a funny moment to choose for trying to cut our small postal revenues yet again."

We hope the international airlines heed Sir Williams warning and face the congress at Ottawa with the solid backing of their governments to resist any further attempts to slash international rates paid airlines for carrying foreign mail.

—Robert Hotz

After all! Fafnir man or not, you should relax occasionally!



Fafnir Super-Precision Ball Bearing for main rotor shafts of jet engines.

Close contacts with the aircraft industry stimulate more than casual interest in its rapidly-advancing developments. Through nearly thirty years of collaboration, Fafnir Bearing Specialists have absorbed some of the spirit responsible for aviation's progress. A case at point is the development of the Fafnir Jet Engine Ball Bearing. This frequently-called masterpiece in bearing design and construction involves a radial and a thrust bearing assembled in a one-piece self-aligning outer ring. The Fafnir Bearing Company, New Britain, Connecticut.

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FIRST — at the turning points in aircraft design

WHO'S WHERE

In the Front Office

Robert E. Gross, formerly chairman and president, now chairman and chief executive of Lockheed Aircraft Corp., Burbank, Calif. **Courtlandt S. Gross**, formerly executive vice president, now president. Also established, three senior vice presidencies: **Charles A. Barker, Jr.**, finance and treasurer; **Cyril Chappellet**, administration; **Hall L. Hibbard**, engineering. **Carl B. Squier**, vice president, becomes assistant to the chairman. **Daniel J. Haughton**, executive vice president; **A. C. Kotchian** succeeds Mr. Haughton as general manager of Lockheed's Georgia Division.

Dr. Arnold O. Beckman, president of Beckman Instruments, Inc., a director of Continental Air Lines.

LaMotte T. Cohu, a director of The Garrett Corp., Los Angeles, Calif. Mr. Cohu replaces **John K. Northrop** who has resigned.

George Haydu, president of newly formed Haydu Electronic Products, Inc., Plainfield, N. J. Messrs. George and Zolton Haydu purchased assets and equipment from Haydu Brothers of New Jersey, a subsidiary of Burroughs Corp.

Dave Gerstein, vice president-sales, government and industrial products, Olympic Radio & Television, Inc., Long Island City, N. Y.

V. G. Nielsen and **Gen. Gordon P. Saville** (USAF, ret.) vice presidents, Ramo-Wooldridge Corp., Los Angeles, Calif.

Najeeb E. Halaby, vice president-company development, Servomechanisms, Inc., Westbury, N. Y.

Honors and Elections

George F. Wislicenus, director, Garfield Thomas Water Tunnel, Pennsylvania State University, will be awarded the Society of Automotive Engineers' Manly Memorial Medal for 1955 for his paper "Principles and Applications of By-pass Turbojet Engines".

John B. Hawley, Jr., president, and **Garold A. Kane**, executive vice president, Northern Ordnance, Inc., Minneapolis, Minn. received the Navy's highest award, the Distinguished Public Service Award, for their important contributions in the design and production of the Navy's new automatic, rapid-fire antiaircraft gun mounts.

Changes

Peter J. Schenk, manager-projects, and **Russel L. Krapf**, manager-finance and administration, for the new Technical Military Planning Operation (TEMPO) of General Electric Company's Defense Electronics Division. TEMPO's headquarters will be in California at a location to be selected. **Charles D. Brown** succeeds Mr. Schenk as manager-marketing, General Electric's Light Military Electronic Equipment Department, Utica, N. Y.

Kenneth L. Moan, administrative engineer, Chandler-Evans, a division of Pratt & Whitney Co., Inc., West Hartford, Conn.

(Continued on p. 70)

INDUSTRY OBSERVER

(EDITOR'S NOTE: *This column was written by* AVIATION WEEK's *staff attending the SBAC display at Farnborough. Pictures on pages* 32-33.)

► Gloster Javelin production order has been drastically cut back to about 100 planes, indicating a slim future for Royal Air Force's all-weather-fighter capabilities. Javelin development plans also were stopped by cancellation of a proposal for a thin-winged model using an area-ruled fuselage and advanced Bristol Olympus engines in the 16,000-lb. thrust class to provide good supersonic performance.

► **Project to build Avro of Canada's CF-105 supersonic delta wing all-weather fighter in England also has been scrapped. This huge supersonic delta would have utilized an American air-to-air missile system and British-built Olympus engines. No plans exist now to provide the RAF with a supersonic all-weather fighter in Convair F-102 class.**

► New version of the English Electric supersonic day fighter is P.1B, with a switch in powerplant from two Armstrong Siddeley Sapphires to a pair of late-model Rolls-Royce Avons with afterburners. This puts the P.1B in the same power class as the McDonnell F-101, but with a much shorter range. Three P.1Bs have already been built.

► **Rolls-Royce reverse thrust device demonstrated experimentally in Hawker Hunter by test pilot Jim Heyworth uses pair of clamshell doors to close off tail pipe exit and divert thrust through louvers located on both sides of the rear fuselage. In normal flight, the clamshells block off louvers but slide backward, opening louver vents, and then close to reverse thrust. Rolls claims up to 50% thrust reversal effect. Unit is being developed along with silencers for eventual commercial applications on the Conway by-pass engine in Boeing and Douglas jet transports.**

► Future of Folland Gnat now is tied mainly to possibilities that the Royal Air Force may place an order for a trainer version under development (AW Sept. 10, p. 28). Gnat trainer will be able to simulate transonic control problems for fighter pilots and will cost much less than its competitor, the Hawker Hunter trainer. Many small countries now anxious to buy the Gnat are hedging until there is some evidence that development costs will be underwritten by other sources. Armed version of the Gnat has flown close to 50,000 ft. and dived successfully up to Mach 1.2.

► **Rolls-Royce is developing two new turbojet engines. RB.106 is believed to be a small, high-thrust weight ratio turbojet in the Soar class, while the RB.108 is an extremely high-thrust turbojet, probably in the 25,000-lb. thrust class.**

► De Havilland Gyron turbojet now running at 19,000-lb. thrust with a design stretch to about 21,000 lbs. has not yet found an airframe application, providing another indication of how Britain's engine development program has far outstripped airframe development in the supersonic speed range.

► **Saunders Roe supersonic interceptor powered by a turbojet and rocket combination is now the only entry left in this field. Parallel Avro project has been canceled because of economy drive of current British government.**

► Most informed people in British aviation are still bemoaning a government decision two years ago to cancel the Vickers 1000 jet transport project. Government decision was based on the fact that the Vickers transport's weight had grown to 280,000 lbs. and would have required 9,000-ft. runways. Douglas and Boeing jet transports that have cornered the bulk of the world market in this class are now over the Vickers weight, and 9,000-ft. runways are assured at most key airports in the long-range jet international traffic pattern.

► **Although several British engine firms are doing research on nuclear powerplants for aircraft, there is no firm high priority program for development of a powerplant-airframe combination similar to the WS 125A in United States.**

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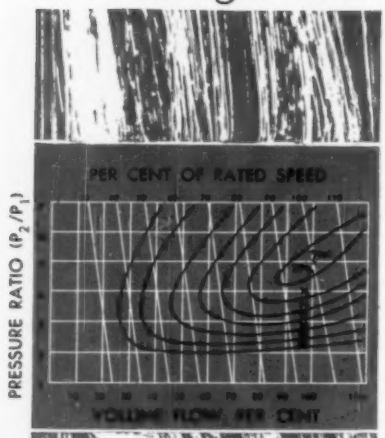

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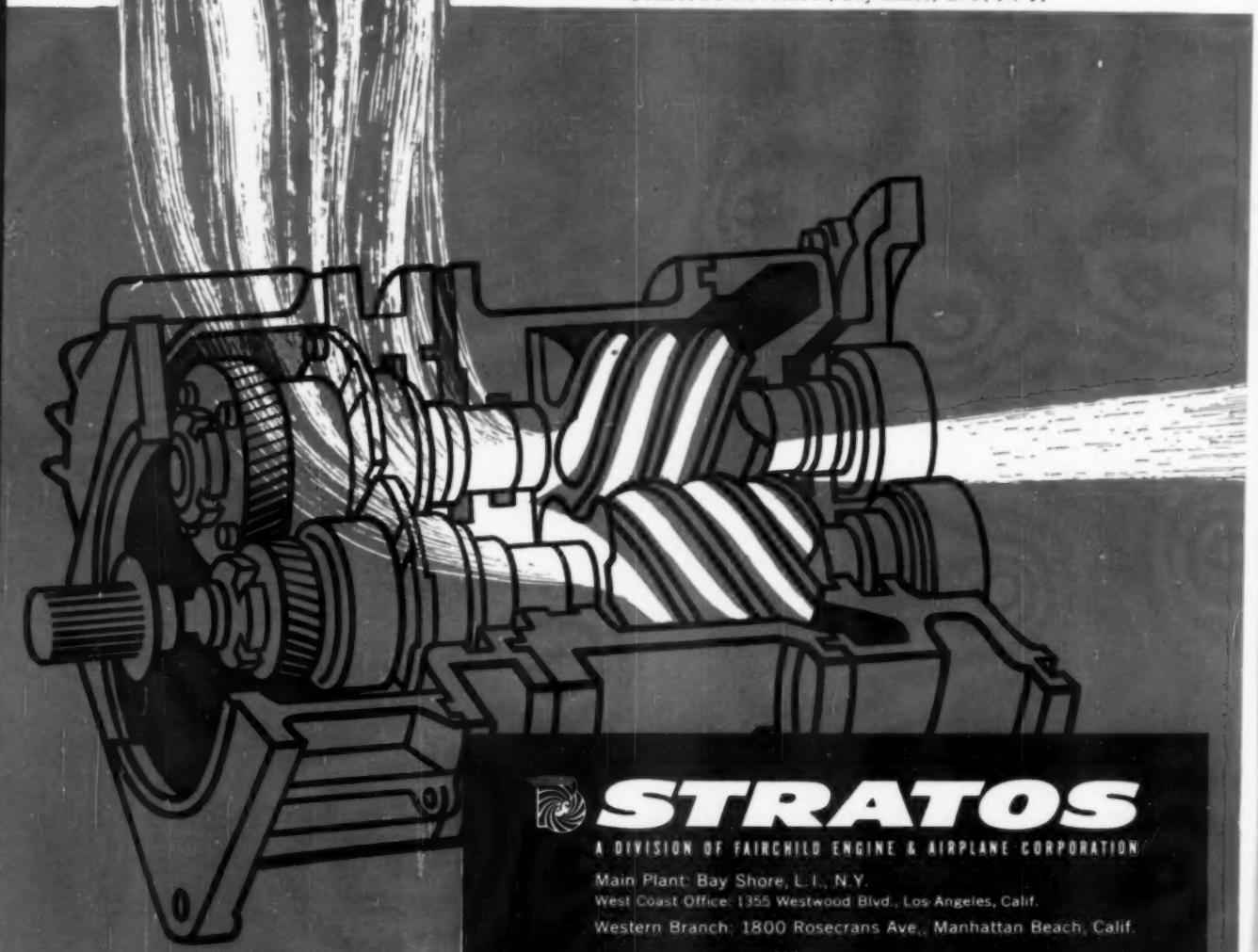

STRATOS

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

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WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

Washington Roundup

AEC and Nuclear Rockets

Atomic Energy Commission's brief announcement that its Los Alamos Laboratory is "concerned with research and development of nuclear rocket propulsion" has been followed by much speculation, little fact. Disclosure that the laboratory's N Division, headed by Dr. Raemer Schreiber, has been working on the problem for the last year, brought out additional information that the Livermore Laboratory also is concerned with nuclear powered rockets. Both are operated by the University of California on contract to AEC. One AEC spokesman said the project still is in the feasibility study stage. There were indications, however, that work may have progressed as far as the development stage. Although no one would say so officially, the Air Force has close liaison with AEC on nuclear rocket propulsion work.

The announcement was primarily a recruiting effort. The AEC said its purpose was to let scientists and engineers know such work existed. The press release itself was hinged upon the employment of an engineer, William F. Carlson, of Bristol, Conn.

AEC Chairman Lewis E. Strauss recently announced establishment of two new programs to assist colleges and universities in training nuclear engineers, scientists and technicians. One provides for grants of up to $350,000 to any one institution for acquisition of equipment, the other for loans of certain nuclear materials and by-products, some of it free and some at 20% of list price.

More Authority for CAA?

The Civil Aeronautics Board and Civil Aeronautics Administration are launching a joint study of regulation of air safety to find out whether some of CAB's rule-making authority should be shifted to the CAA. CAA feels that in some regulator fields, it would be a more effective rule maker because of its more intimate contact with the problems involved.

The CAB held discussions early this month with representatives of the airlines, the military, pilots, controllers and the CAA to study air traffic regulation. Further discussions will be held in an effort to find solutions for air traffic problems.

'Reasonable Probability'

Comment of Dr. Clifford C. Furnas, Assistant Secretary of Defense for Research and Development, on the artificial satellite during a talk before the American Institute of Chemical Engineers:

"The well-publicized scientific satellite, which has a reasonable probability (though not necessarily a certainty) of success, is the most important aspect of the program of the International Geophysical Year.

Soviet Talent Production

Add statistics on Soviet training of technical specialists (including scientists, engineers, agriculturists and doctors): ". . . Our best information indicates that the Soviets are graduating these specialists at a rate not only greater than ours but at a rate greater than that of all NATO countries combined. For example, during the next five years we estimate that Soviet engineering higher educational establishments will graduate about 420,000 people—about triple our rate."—Air Force Chief of Staff Gen. Nathan Twining. Gen. Twining illustrated the problem with this example: "This year International Business Machines estimates that 7,500 mathematicians will be needed to man computers on order, of which about 1,500 should be Ph.D's. Here is our output: About 250 Ph.D.'s in math will graduate this year."

Tighter Airways Control?

House Commerce Subcommittee on Aviation, headed by Rep. Oren Harris (D.-Ark.), is pushing for tighter control of scheduled airline traffic. "We are going to have more airways—even if the airlines don't want it," Harris said last week during the revived subcommittee hearings. "We are going to revise the airways and require the airlines to fly in the airways."

James Pyle, acting Civil Aeronautics Administrator, and Oscar Bakke, deputy director of the Civil Aeronautics Board's Bureau of Safety Regulation, argued in favor of the present CAA and CAB policy of free and visual flight in non-density areas against the solid opposition of the six subcommittee members present. "See and be seen" is still the program of the day, Bakke testified. He reported that there is only "a very, very small percentage of aircraft under positive control at present." In line with its program for positive control of fast and high flying jets, Pyle pointed out that the CAA will have control over traffic above 24,000 ft. by April, 1957, and traffic above 15,000 ft. by Feb. 1958.

Committee members, however, were not satisfied.

Harris observed that there has been no basic change in flight rules and regulations for 15 years, and that the only substantial change came as a result of the conflict over instrument landing system (ILS) versus ground control approach (GCA) in 1947. He added:

"We must wake up to the fact that you can't drive a Cadillac under the same rules that apply to a horse and buggy. There can't be freedom of the air when there are going to be jets flying through it."

Subcommittee members maintained that there is a possibility that the Grand Canyon collision between TWA and United Air Lines airliners on June 30 might have been avoided if the United plane had been posted by CAA ground personnel as to the location of the TWA aircraft. The TWA aircraft was notified of the location of the United plane through the TWA office when it requested a change in flight course.

The CAA and CAB also were criticized by committeemen for failing to take action banning the practice of commercial airliners of flying low over the Grand Canyon area for sight-seeing purposes. Bakke conceded that this practice is one of the possibilities that might have figured in the Grand Canyon crash.

ALPA vs. USAF

Air Force Secretary Donald Quarles has agreed to review the pros and cons of a recent USAF directive calling for removal of key airline personnel from the Air Force and Air National Guard ready reserve (AW Sept. 3, p. 39). Most aviation officials, however, held little hope that a solution agreeable to the Airline Pilots Association, which is fighting the directive, would be reached. A conference held in Washington last week brought the issue no closer to a satisfactory conclusion.

—Washington Staff

Freer Rein for Industry Recommended

Defense Department study calls for better utilization of management skills in weapons development.

By Claude Witze

Washington—Fuller utilization of the aircraft industry's management skills is essential in order to speed the development and production of new weapon systems, the Defense Department has warned Army, Navy and Air Force.

The major conclusion of an extensive study of the aircraft cycle from concept to inventory is that more responsibility should be given to industry. The report, drawn up by a group headed by Deputy Secretary of Defense Reuben B. Robertson, Jr., indicates that the armed forces are failing to get full benefit from the aircraft industry talent it hires.

"We feel," a Defense spokesman told AVIATION WEEK, "that aircraft procurement officers need a far better definition of what the industry can do. Then the industry should be given a contract and, along with it, the widest possible freedom to fill the contract."

In this connection, it was indicated that the study group has been favorably impressed by USAF's source selection system, although it does not specifically endorse the program.

Lower Echelons, More Power

Second most important recommendation is that lower echelons of military procurement personnel be strengthened, then given more authority. This would apply to USAF's Weapon System Project Offices (WSPO) and the Navy class desks.

The study blames much of the delay in aircraft development on the fact that decisions are held up while pieces of paper are circulated to a high level in the military organization.

Blame for this lies in the lack of sufficient personnel. USAF, for example, says frankly that it does not have the management talent to guide all new weapon systems along the path from concept to inventory. This is why it hires aircraft companies to do the job. In exceptional cases, it has even hired special management consultants, such as Ramo-Wooldridge Corp., which is responsible for systems engineering and technical direction of the intercontinental ballistic missile.

The study group feels that, within the military, total authority over a weapon system project should be vested in a single office. This office, WSPO or Navy class desk, must have a staff competent in size and quality to do the job and make its own decisions.

On many projects under the present system, an aircraft company is hired as prime contractor to provide management skill. Then it is not permitted to exercise the skills fully because vital decisions are delayed in the military routine.

There are, the report says, two remedies. One is to raise the status of WSPO or class desk to the point where it has the competence and authority to make decisions without fighting its way to the top.

Other Recommendations

Second remedy is to improve communications on the state of the art so that the military men know the relation between what can be done and what the armed forces need. This is well illustrated by the Ramo-Wooldridge ICBM arrangement, where the management contractor was hired to provide precisely this service. It is Ramo-Wooldridge's job to know what industry can accomplish and to set up a development plan capable of attainment.

Other recommendations of the Aircraft Study Group include:

- **Greater dissemination** of technical information and requirements to contractors.
- **Increased stimulation** of new ideas among the military services.
- **Faster action on contractor requests** for government-furnished facilities.

USAF's program for circulation of Technical Program Planning Documents and System Requirements (AW Aug. 6, p. 86) to a selected list of potential contractors is considered a substantial advance towards proper dissemination of technical information. But the study group's survey of industry showed some manufacturers still need more data and consider present efforts inadequate.

In this connection, staff members feel there is a vital need for more background information on the state of the art.

Equally essential is communication—to get the data to the place where it will do some good. Bottlenecks and excessive security regulations are factors in this situation. Development is delayed because big steps in the state of the art can be missed entirely until development is finished and an obsolescent weapon produced, or abandoned because a key man did not know a key fact.

Lack of new ideas inside the military is an old complaint, cited a year ago by the Hoover Commission when it accused the armed forces of conservatism in seeking new approaches. Probably this is more true outside the field of air weapons, but there are problems in the budget, mission and communication fields that tend to sterilize the military mind when it is faced by new technological facts.

Time in Processing

On government-furnished facilities, the study group feels too much time is spent processing requests. Here again is the stumbling procedure of sending a piece of paper from desk to desk, forcing key people to make their decisions one after the other. Concurrent review with simultaneous action is urged to speed decisions.

With emphasis on more timely and better-informed policy decisions, the study group sees a need for "more concentrated attention on the development of operational requirements, more complete facts to justify a new requirement, more adequate policy review of new weapons requirements and more effective policy attention to long leadtime technical problems."

There is a strong feeling that the armed services do not get the most out of their best technical information, which comes from such places (in addition to industry) as the National Advisory Committee for Aeronautics, Massachusetts Institute of Technology and other institutions and laboratories. What is needed, in the opinion of the staff, is a more orderly arrangement of the facts and proficient funneling to men who write military requirements.

First Flight of F-107

Los Angeles—North American Aviation's F-107, an advanced version of the F-100 series, made its first flight last week from Edwards AFB. Pilot for the flight was Robert Baker, North American's chief engineering test pilot.

At the end of the 35-minute flight, which Baker termed "very satisfactory," the aircraft's drag chute failed on landing, and the F-107 rolled from Edwards' 15,000-ft. runway onto Rogers Dry Lake bed, where the nose gear collapsed when it struck a ditch. Damage to the aircraft was slight.

The F-107, originally designated the F-100B, has a solid nose, with a bifurcated air intake on top of and behind the cockpit. Speed is comparable to that of the Republic F-105. Powerplant is a Pratt & Whitney J75 with afterburner.

"The job of getting information around to the right people at the right time, is not a simple thing," one group consultant said. "An improvement is necessary if we are to keep the development of requirements from interfering with the speed with which new weapons are perfected."

It was pointed out that time is consumed in the development of new ideas when there is no concentrated study of their application. A breakthrough in the state of the art in a single area can easily change the entire concept of how a new airplane will be used. Usually these breakthroughs are in the field of propulsion or avionics and result, for example, in the switch of a fighter into a fighter-bomber.

Single Recommendation

The study group makes a single recommendation regarding the existing Armed Services Procurement Regulations (ASPR). It favors attention to ASPR limitations on the percentage of profit that can be allowed for outstanding research and development work, particularly by small companies.

The study disclosed that many small firms feel the advantage goes to big prime contractors, to whom the profit limitation clauses are of little importance because they are making more substantial amounts on production contracts. Many of the smaller companies can make worthwhile contributions to the research-and-development effort but are discouraged by the curb on incentive.

It was stressed that the study group report does not constitute a Defense Department Directive. Rather, the result is a list of "Major Action Objectives," and the armed forces are charged with drafting proposed implementation plans, which should be ready early next year.

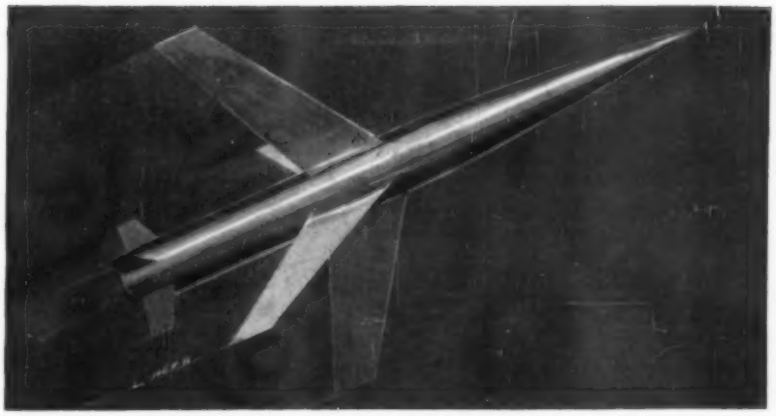
The work is a joint effort and Army, Navy and Air Force were represented in making the recommendations. Now they are expected to find their own best way of carrying them out.

In the course of its study, the staff visited every major manufacturer of manned aircraft, including helicopters, and most major component makers. Data was collected from more than 600 representatives of the Defense Department and 30 aircraft manufacturing and research organizations.

The complete report of the study group is classified (AW Sept. 10, p. 25). The Defense Department did release a 12-paragraph statement on the subject, which contained a negligible amount of positive information.

Members of the study group, in addition to Deputy Secretary Robertson, are:

- **W. J. McNeil,** Assistant Secretary of Defense (comptroller).
- **Frank D. Newbury,** Assistant Secretary of Defense (applications engineering).
- **C. C. Furnas,** Assistant Secretary of Defense (research and development).
- **Robert C. Lanphier, Jr.,** Deputy Assistant Secretary of Defense (supply and logistics).
- **Charles C. Finucane;** Under Secretary of the Navy.
- **James H. Douglas, Jr.,** Under Secretary of the Air Force.
- **David L. Chewning,** staff director.
- **Thomas D. Morris,** chief consultant.



Lacrosse Missile

Lacrosse missile, shown in this Aviation Week artist's conception, is a tactical weapon developed for close support. Complete system design and development responsibility was given by Army Ordnance to Cornell Aeronautical Laboratory. Subcontractors worked with the laboratory on ground equipment. Production of the missile is underway at Glenn L. Martin Co. Marine Corps, one potential user of the system, has begun sending personnel to Redstone Arsenal, Ft. Sill and Martin for preliminary instruction in the use of the weapon. Lacross is rocket-powered, has all-weather guidance system not requiring observation of the missile during flight. Range is approximately 10 mi.

ARDC Sponsors Study Of Infra-Red Radiation

Baltimore—A three-week Air Force-Army-Navy study to establish techniques for distinguishing between the infra-red radiation from ground and airborne military targets and the radiation from their backgrounds is being conducted in the Pikes Peak area of Colorado.

Five measuring stations have been established, two of them on Pikes Peak. Targets such as aircraft, tanks, trucks, self-propelled guns and cities will be measured, both from the ground and from various altitudes in the air.

Air Force's Air Research and Development Command is sponsoring the 160-man team.

Others taking part are Chicago Midway Laboratories, Engineer Research and Development Laboratories, Naval Ordnance Test Station, Naval Air Missile Test Center, Ramo-Wooldridge Corp., Ohio State University Research Foundation, Scripps Institution of Oceanography, Servo Corp. of America, Southern Research Institute, University of Michigan's Willow Run Laboratories, Barnes Engineering Co., Army's Detroit Arsenal, U.S. Weather Bureau, U.S. Forest Service and Aerojet General Corp.

Dr. Max R. Nagel of ARDC's Wright Air Development Center is directing the expedition.

Navy Seeks Turboprop Observation Design

Washington—Navy has given airframe manufacturers until Oct. 29 to propose design for a two-man, 300-kt. turboprop observation plane for use by the Army and Marine Corps (AW May 14, p. 31), using either the Avco Lycoming T53 or General Electric T58 turbine engine.

The Army has favored tandem seating, and the Marines have favored side-by-side (AW June 4, p. 34), but specifications now make visibility the criterion, leaving seating arrangement optional.

Services hope to contract for development of one or more designs by early 1957.

Earlier this year, Army said it wanted the observation plane to be capable of landing and taking off from a 500-ft. field over a 50-ft. obstacle, and of making quick, deep penetrations of enemy areas at speeds high enough to give the pilot and observer "additional survival capability."

At the same time, it must be able to slow down to 100 kt. for detailed observation and for protection from faster, less maneuverable fighter aircraft; to carry no armament and no armor except possibly for flak curtains.

FRENCH AIR FORCE Sikorsky S-58 helicopter lands between two others at Air Force base at Boufarik.

Special Report from Algeria, Part 1:

French Meet Guerrillas With Helicopters

By Robert Farrell

Algiers—Troop carrying helicopters—Sikorsky S-55s and S-58s, Vertol H-21s and Bell 47G-2s—are flying more than a third of the 700 missions French air forces average weekly in the Algerian campaign.

Bell 47s and Sikorsky S-55s are doing a fine job for the French, but recent additional orders for 50 Vertol H-21s and 150 Sikorsky S-58s underscore the interest of the French in these larger types. French Defense Ministry was so impressed by their performance that it went ahead with the orders despite real difficulty in finding the money and disagreement of the French Air Force and Army over which type is best suited to the campaign.

Piston Planes

Dealing with the rebels has brought little need for jet equipment, which is too costly to use against an enemy which rarely appears in numbers. Besides, many bases in Algeria have not been modified to handle jet fighters.

Mistral jet fighters are in operation. But of the 300 light fighters the French expect to have in operation by year-end, a sizable proportion will be North American T-6 trainers, generally modified to carry four machine guns and six rockets in underwing mounts. French say the T-6 is nearly ideal for their operational needs.

Less than 10% of aerial activity has been direct strafing and bombing attacks against the rebels. However, the French Air Force will enlarge this percentage when current equipment shortages are erased. Main job of the French Air Force has been troop carrying, border patrol (to prevent supplies reaching the rebels), observation, and evacuation of wounded.

French Air Force has adapted itself completely to ground force requirements, and air headquarters at Algiers coordinates but does not initiate missions. Ground forces have three divisional headquarters: Oran, Algiers and Constatine. To each division is attached:

- **Mistral or F-47** tactical air group.

The 14-year-old Republic fighters have suffered operationally, as typified by one squadron that lost a dozen during summer operations mostly because of engine failure. "The only thing wrong with the F-47," the squadron leader said, "is its 14 years." Negotiations are under way to obtain Douglas AD Skyraiders from the United States, with Chance Vought F4U Corsairs as second choice.

- **Noratlas, C-47 or Dassault** cargo-transport planes, assigned as a transport group.

Divisions are broken down into 18 subdivisions where aerial operations generally are controlled. These centers are assigned, besides helicopters and T-6s:

- **SIPA and Morane** light trainer-fighters.
- **Broussard** observation transport craft.

But the French emphasis seems to be strongest on helicopters, for which orders placed at home and abroad have reached close to 600. Included are 100 H-21s and 220 S-58s.

U. S. Designed

Helicopters presently being used in Algeria are U.S.-designed, though all

the Bell 47s and some S-55s are foreign-built. Actually, intensive troop-carrying operations by helicopter only began in earnest last spring. The H-21s and S-58s just began operating this summer.

French Air Force and Army presently are operating in Algeria a fleet of only 90 helicopters, including 11 H-21s and nine S-58s. In addition, the French Navy, working with the Army, is running two H-21s.

This overall figure reflects losses due to accidents which reportedly involve a dozen ships, including two H-21s and two S-58s. In some cases the ship was not entirely washed out.

The main interest at the moment centers on the H-21 and the S-58, and their use in commando assault operations during much of July and throughout August.

The commando-via-helicopter operations, the first time such a system has ever been used, generally are carried out after a request comes in from a ground force commander for aid in clearing out an area where a rebel band has been spotted. Ships are assigned to the mission, usually in groups of threes, and fly about 50 to 75 mi. to the pick-up point. This point, whenever possible, is located near a fuel dump—of which there are scores scattered about the country—so that the helicopters will have full time for the mission.

Troop loading takes place quickly; the number carried, ranging from eight to fifteen, very often depends more on the temperature and altitude than on whether the ship is an H-21 or an S-58.

Once troops are loaded the rotation gets under way. The helicopter generally flies an average of 10 mi. only, but over exhausting territory that would take troops all day to cross or climb. When the drop zone is reached the helicopter either lands and lets off the troops or else hovers while the commandos leap out. Very often the drop zone is an extremely small area. In that case, the helicopters queue up until their turn comes around. Hovering queue of six to ten ships is not unusual.

Once unloaded, the helicopter flies back to the pick-up point and rotates again, keeping it up until all the troops have been placed in position.

Sting Removed

By this operation the French have taken much of the sting out of the rebel tactics, plus giving a tremendous morale boost to their own troops. Before the use of heavy helicopters, rebel bands would pick a fight at will with French troops by surprise attacks in mountainous areas. Their damage done, the rebels would break off the engagement and retreat up the mountain slopes and passes where the French found it almost impossible to follow. Now, shortly after a battle begins, the French rotate troops around the rebel position so that when the rebels try to retreat into the mountains they run into waiting commandos, fresh for battle.

Helicopters try to stay clear of the actual combat area. This isn't always easy to do, which is why many are pocked with hits. Once a battle is over, the wounded are embarked and

'Les Peepers'

The French call them "Les Peepers" and they have proved superior to all other light observation craft operated in the Algerian campaign. These are the Piper Cubs, operated to the annoyance of the Air Force by the French Army, and being used in increasing numbers.

Pipers have done excellent "convoy duty." Rebel bands had been successful in ambushing military columns moving over mountain roads, but the French found that if they flew even an unarmed Piper Cub over the troops the rebels stayed under cover.

ARMY'S VERTOL H-21 hovers in Aures Mountain region before landing. Army and Air Force differ over merits of H-21, S-58.

SIKORSKY S-55 helicopter lands with reinforcements on plateau in central Algeria.

NORTH AMERICAN T-6 is run up in Algeria. Three rocket mounts are under each wing.

REPUBLIC F-47, leaving for mission from central Algerian base, also mounts rockets.

flown to base hospitals within an hour of being hit.

An objective answer to the controversial question as to which helicopter—the H-21 or the S-58—carries out these commando operations best is hard to come by. For one thing, both have only begun to be used in combat by the French. More important, the virtues and vices of each craft have been clouded by a dispute between the French Air Force and Army, not unlike the differences between the U.S. services.

French Air Force flies the S-58 in Algeria and claims it does a better job than the H-21. Conversely, the Army uses the H-21 and insists it is better all-around than the S-58.

French Navy apparently likes both. It has ordered the S-58, since the H-21 is too big for elevator handling on French aircraft carriers. Yet the Navy is flying the two H-21s in Algeria and has more on order. Actually, the Navy was the first military branch to interest itself in helicopters and seems to take an amused interest in the Air Force-Army battle over helicopter qualities. Navy pilots have built up bi-rotor time on 19 HUPs ordered for them some time ago.

Under the present military set-up in Algeria, the Air Force and Army don't operate their helicopters in the same areas. The country—which is as big as the U.S. east of the Mississippi River—is divided in half. Air Force is responsible for helicopter requirements in western Algeria, Army for eastern Algeria. Both claim they have the most difficult territory.

Test of Both

French have held a combined evaluation test on the two helicopters, and it was over this test that the two services clashed. It is worth noting that the Army was committed to the H-21 and the Air Force to the S-58 even before the test was held. Official results have not been disclosed, but several facts can be stated.

The evaluation test was carried out in two parts. The first took place over a 10-day period early in July at Batna, in the rugged Aures mountain region. The second was held later in the month near Algiers, at sea-level. The H-21 was flown by French Army pilots, the S-58 by French Air Force pilots. Officials of the three services, the Defense Ministry and civilians, including representatives of Vertol, Sikorsky and Curtiss-Wright, were present.

According to reliable witnesses, the S-58 out-performed the H-21 though many say the Work Horse proved to be a more versatile ship for ground force requirements. The Army officially admits the S-58 put on a better performance, but insists that the H-21

clearly demonstrated its adaptability to ground force tasks.

On a range test, with a payload of 1,200 lb., the H-21 reportedly was credited with 282 nautical mi. The S-58 was credited with 375 nautical mi., though its fuel tank capacity is 43 gal. less than the H-21.

Recently, however, at the Army helicopter base at Setif, a new H-21 range test was carried out by the Army under the same conditions that were imposed during the official evaluation test. An H-21, piloted by Vertol's William H. Coffee, flew 340 nautical mi., a decided improvement though still 35 nautical mi. short of the S-58 mark.

Another test during the official evaluation involved a rotation contest. Reportedly each ship had to transport 150 troops 30 kilometers. The contest, incidentally, was held at sea level. The H-21 carried 20-21 troopers, for which it has that number of seats. On the first run, according to one observer, the S-58 also lifted 21 troopers but a French official complained of "subway rush-hour conditions" within the ship, and from then on the S-58 was permitted to take only 15 troopers, for which it has that number of seats.

Reported upshot of the contest was that the S-58 made each rotation in a faster time than the H-21, but the latter carried more each trip.

This contrast of performance versus utility is noticeable when discussing the two ships with Air Force and Army officers. The former invariably mention performance in terms of rate of climb, forward speed, etc., while the Army dwells on utility.

Thus the Air Force cites the fact that in testing the S-58, they found it could climb to 14,000 ft. in 11 min. and that it flies at 100-kt. free load and from 80-90 kt. under load. The Army, on the other hand, talks more about the two doors on the H-21, enabling fast troop evacuation, and ease in handling spare blades or hauling cargo like field pieces and telephone poles. Army also talks up the H-21 cargo sling, its 12 litters instead of the S-58's eight, the H-21's free access between pilot and troop commander inside the ship, placement of the fuel tank well aft of pilot and troops, and finally, the H-21's provision for carrying more troops.

In troop-carrying, however, there doesn't seem to be much difference between the two when operating at high altitudes, as is often the case in Algeria. Both the H-21 and the S-58 have been carrying 12 troops on combat missions, rarely more than that.

Understandably, the French would like to see some modifications made on both. Army, for example, is pushing for self-sealing gas tanks on the H-21. Main tank on the S-58 already is self-sealing. Army is also interested in the idea of installing a turbine engine in the H-21, for the ship is designed to take heavier loads than its present powerplant is capable of lifting. This is not so much the case with the S-58.

The S-58 is powered by a Wright 1820-84 engine; the H-21 by a Wright 1820-103. The S-58 has a take-off rating of 1,525 hp., or 100 hp. more than the H-21.

This extra power, according to observers on the scene, has occasionally enabled the S-58 to perform varying operations—such as hovering under certain conditions or lifting straight up out of a confined area for some distance—that probably would have stymied the H-21, or at least strained its engine.

The dispute over which ship can land and takeoff anywhere is still going on between the Air Force and Army. The evaluation test apparently wasn't conclusive. The Air Force claims the H-21 needs open space to move forward once it gets clear of ground effect. The Army answers that this isn't always the case, and claims that the H-21, with both rotors high off the ground, can land in underbrush that would foul the tail prop on the S-58. The Army also claims the Air Force is having trouble with ground resonance when landing the S-58 on soft terrain.

Disinterested observers think the best answer is that the S-58 can get in and out of spots that the H-21 couldn't, and vice versa. With its two doors, for example, the H-21 has a clear advantage on slope landings under certain wind conditions. Yet the S-58 reportedly is easier to land than the H-21 due to its extra power and the fact that its main gear is under the pilot. In rough areas an H-21 pilot can't be sure just where his main gear is settling.

The Army's answer is that this isn't a problem for a good pilot.

A large proportion of the Air Force officers interviewed by AVIATION WEEK in Algeria felt that what was being done with helicopters in the present fighting could not be done in a so-called classic war. Helicopters in Algeria are comparatively free to fly wherever they please without serious danger of enemy retaliation. This wouldn't be the case, many Air Force people believe, in a conventional war.

Majority of Army officials, however, believe that the helicopter lessons being learned in Algeria are very important for future wars, particularly atomic wars where troops must be moved about quickly. Army feels that future helicopters, capable of carrying 50-100 men at least, will have to have two or three rotors. That's why, Army says, it wants to build up experience on ships like the H-21. Huge single-rotor ships, the Army believes, would involve problems of ground resonance and, with larger rotor diameters, appropriate landing areas.

How the Paris government feels about the S-58 versus the H-21 controversy is best seen by noting its action after the evaluation test results were all in. It ordered both.

(This is the first of three articles on French use of helicopters in the air phase of the Algerian campaign.)

H-21 Maintenance Pact

Morton, Pa.—Vertol Aircraft Corp. announced that a Bremen, Germany, firm will handle the maintenance, overhaul and repair of H-21 helicopters located in Europe.

The work will be carried out at the Lemwerder and Einswarden plants of the company, Weser Flugzeubau, Finanz-und Verwaltungs-Gesellschaft. The licensee agreement also gives the firm an option to build H-21s for sale in Europe and Africa.

The West German government has placed an order for 20 of the helicopters. They already are being used by the French Army in Algeria.

Proximity Device Orders

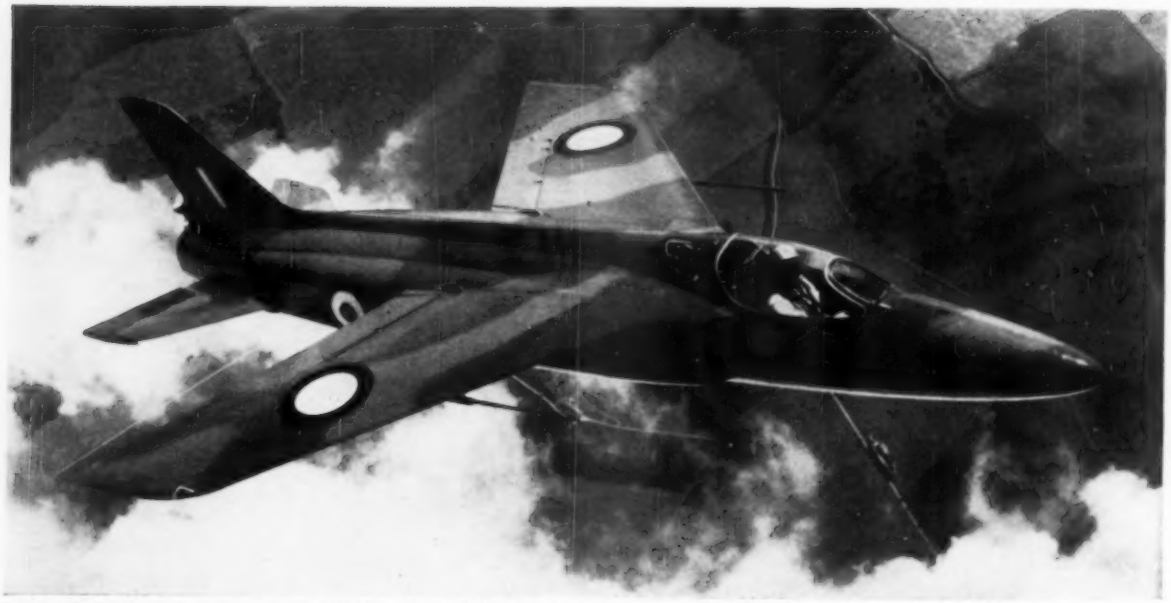
New York—Several airlines, including American, National and United, will order proximity-warning/collision-avoidance systems from Collins Radio Co., following Air Transport Assn. selection of Collins' technical proposal for an FM-CW system as the best of 10 submitted in competition. Unusual airline action in ordering equipment which has not yet been developed reflects industry's concern over the problem. Collins expects to flight test a prototype proximity warning device (phase I of a two-part program leading to collision avoidance) in 12-15 months.

Qantas Buys Seven Boeing 707 Airliners

Qantas Empire Airways has ordered seven Boeing Stratoliners for its international services. With the order, the Australian carrier plans to be the first foreign airline to put American turbojets into service.

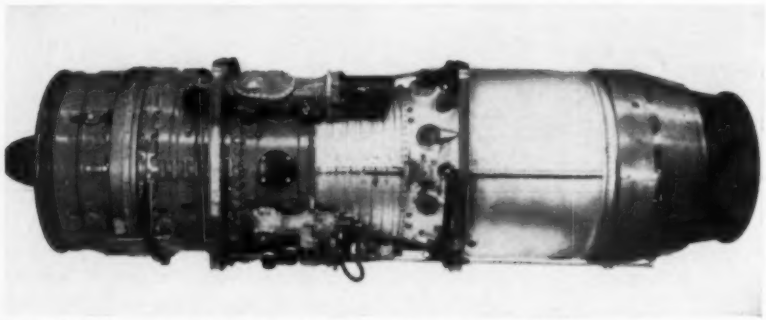
Delivery of Qantas' seven Boeings is scheduled for the period between May and September 1959. This schedule will permit it to put its jets in service that year.

The Qantas order is for the 707-138 with Pratt & Whitney J57 engines, the smallest of the Boeing 707 series. The turbojet transport will carry 70 to 120 passengers and a full payload of 34,500 lb. Cruising speed will be 550 mph.; range 3,500 miles.

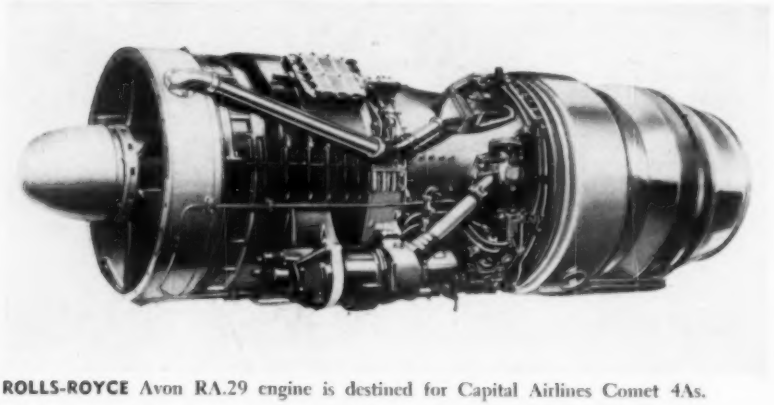


FOLLAND GNAT, now powered by 4,000-lb. thrust Bristol Orpheus engine, gave striking demonstration at the SBAC show.

British Air Industry Shows Wares at Farnborough



PORT SIDE view of Bristol Olympus BO1.6 engine rated at 16,000 lb. thrust.



ROLLS-ROYCE Avon RA.29 engine is destined for Capital Airlines Comet 4As.

Emphasis at the 17th display of the Society of British Aircraft Constructors show at Farnborough was on sales rather than technical achievement (AW Sept. 10, p. 26). Some displays, like the Rolls-Royce Avon RA.29 engine, combined both.

Specifications of the Avon RA.29, which will power Capital Airlines Comet 4As, report 10,500 lb. maximum thrust; specific fuel consumption at sea level takeoff at .775 lb./lb./hr.; net dry weight 3,341 lb., length 124.8 in. and diameter 42 in.

Bristol's Olympus is the highest rated British engine officially—16,000 lb. thrust—but the de Havilland Gyron unofficially is rated at 19,000 lb. Another Rolls engine shown, the Tyne (center, next page) is scheduled to power the Vickers Vanguard and is being tested for the Lockheed Electra. The turboprop engine delivers 4,770 eshp.

Little new in the way of supersonic fighters was shown, but the Folland Gnat, designed and built as a private venture, put on a lively display. Flight trials of the second armed Gnat are expected to begin this fall.

Fairey Fireflash appeared on Swift and on Hunter, but is not in operational use on either. Super Sprite rockets, that have been developed by de Havilland as auxiliary powerplants, gave the Vickers Valiant bomber short field takeoff capabilities.

PROTOTYPE Vickers Supermarine Swift Mk. 7 is shown fitted with two Fairey Fireflash air-to-air missiles.

ROLLS-ROYCE reverse thrust unit is installed in the tailpipe of a Hawker Hunter F Mk. 6 fighter. Outlet grills are on each side of rear fuselage.

AVRO LINCOLN is test bed for Rolls-Royce Tyne turboprop engine.

VICKERS VALIANT bomber takeoff run is cut with the aid of two de Havilland Super Sprite rocket engines (AW Aug. 20, p. 34).

PARTY of Soviet air officials, headed by the Minister of Aircraft Production, Peter Vasillievich Dementiev (center, wearing hat), visits the SBAC show at Farnborough. Comet jet transport plane is in background.

Britain Opens Curtain for Soviets

Farnborough, Hants, England—Russian delegations visiting Britain for the SBAC flying display in reciprocity for Royal Air Force and aircraft industry groups that toured the Soviet Union last summer, saw far more here than western visitors were shown at Tushino time.

The Russians at the Tushino air show allowed only quick glimpses of military aircraft in flight and ground inspection from moving cars. At the SBAC show, Russian visitors were permitted close and leisurely inspection of British military and transport aircraft on the ground in addition to the flight performances.

Commander of the Red air force flying training command, Lt. Gen. Alexei Blagoveschcensky, was permitted to fly a Hawker Hunter two-seater trainer when he asked to do so. He was taken up by Hawker deputy chief test pilot William Bedford for two flights. On the second, the Russian general made a supersonic dive and a landing.

This performance was particularly irritating to the British press who have been barred from making flights in the Hunter trainer for security reasons.

The two-seat trainer has a less-powerful Rolls-Royce Avon engine than the Mark 6 fighter now going to the Royal Air Force.

The Russians scored another first when they saw the Armstrong Siddeley production line for Sapphire turbojet engines. This is a much-higher-powered axial engine than the Russian centrifugal flow jet engine shown westerners during a plant tour in Moscow last summer. The Russians also visited the Sperry instrument plant and the National Physical Research Laboratory in addition to four Royal Air Force stations.

Aerophysics Develops Hypersonic Rockets

Washington—Development of the first of a family of hypersonic research rockets was announced last week by the Air Force and the Air Research and Development Command.

Existence of the hypersonic test vehicle (HTV) was reported by AVIATION WEEK on April 23 (p. 31).

Twenty experimental models of the two-stage, solid propellant rocket have been fired at ARDC's Holloman Air Development Center. The HTV, now nearing standardization, was developed by Aerophysics Development Corp., a subsidiary of Curtiss-Wright Corp., in conjunction with ARDC's Wright Air Development Center.

Booster stage of the HTV consists of seven rockets with three fins. The second stage consists of four rockets and four fins (AW Sept. 10, p. 33). Each stage is 5 ft. long. The booster is 9 in. in diameter, and the second stage is 6 in.

A two-foot nose cone contains a magnetic tape recorder that charts rocket acceleration and nose cone temperatures and pressures.

Nose cone configuration, dimensions and composition may be changed, and the effects of the changes studied in relation to hypersonic flight, giving data on aerodynamic shapes, aerodynamic heating, rocket stability and pressure distribution, according to ARDC.

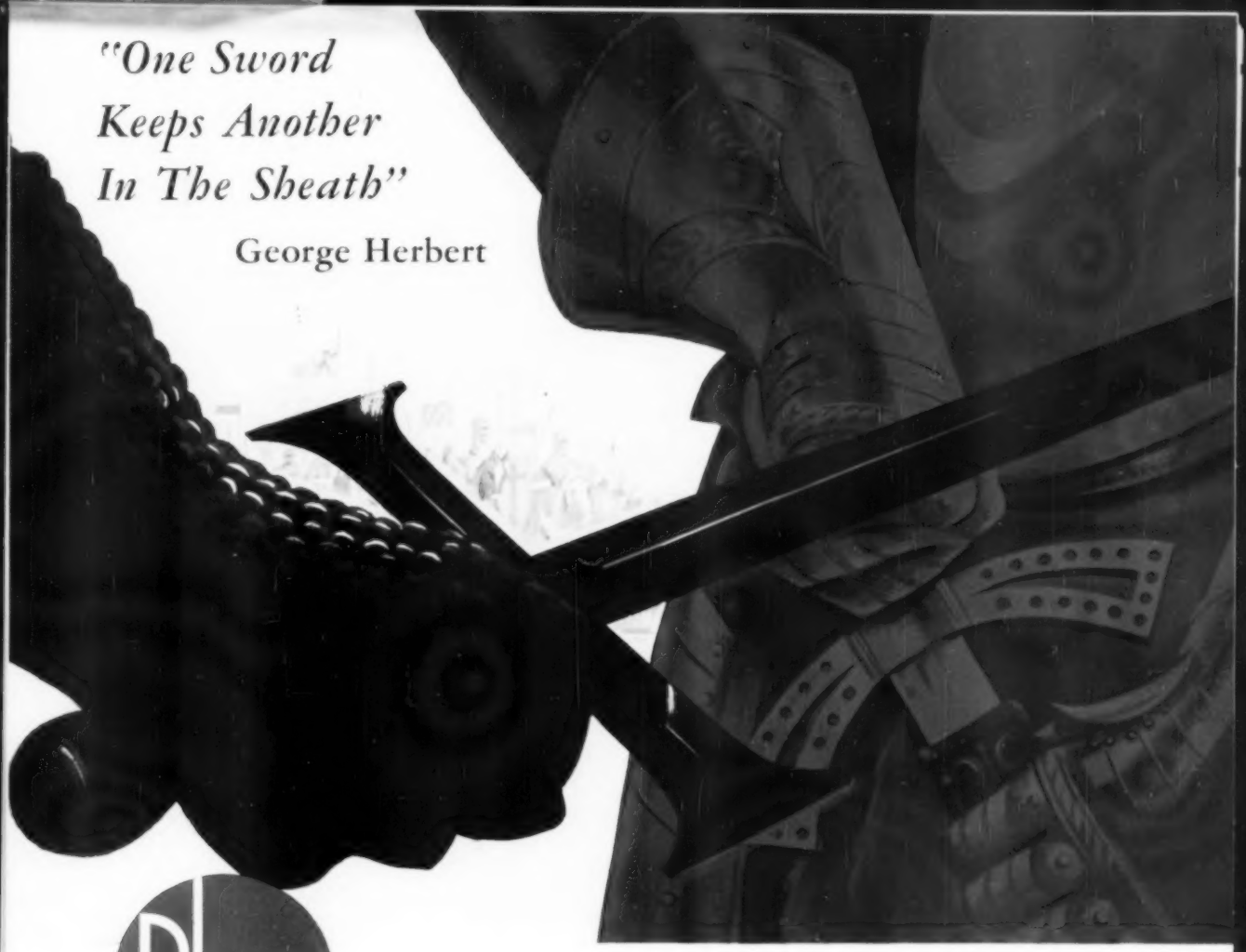
HTVs are fired from a 16-ft. portable launcher. All seven booster rockets are ignited simultaneously. Separation ignites the four second-stage rockets. A speed several times that of sound is reached two seconds after launch. Six seconds after burn-out, three laminated glass fiber fins are blown off the second stage by small charges within the rocket, and the main body and nose cone tumble to earth in a flat spin at about 100 mph.

HTVs are expected to cost about $5,000 each. Work on the $1 million contract began in 1953. First flight was in November, 1954.

Dr. Roscoe H. Mills, chief of the fluid dynamics research branch of WADC's Aeronautical Research Laboratory, is directing the research. Kenneth F. Stetson and Lt. John H. Lane are WADC task scientists on the project. (Picture of Aerophysics' hypersonic test vehicle appears on page 116.)

"One Sword Keeps Another In The Sheath"

George Herbert



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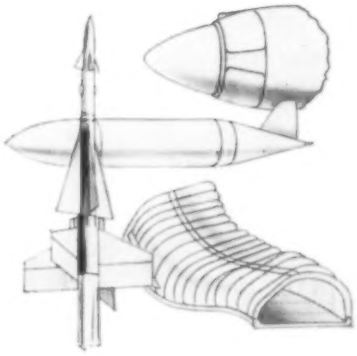

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Crowds Drawn by Air Show Save Canadian Event From Extinction

By Alpheus W. Jessup

Toronto—U. S. Navy's Blue Angels flying Grumman F9F-8 Cougars and a French test pilot in the Fouga Magister 170 light jet trainer stole the show at Canada's Third International Air Show.

Held in conjunction with the Canadian National Exhibition for the first time, the air show was viewed by nearly 460,000. Prior to the last two days, exhibition attendance was off 30,000. Largely due to the air show, the last two days' crowds more than made up the decrease and set a new record for the two-week exhibition.

This crowd pulling-power probably saved the Canadian International Air Show from extinction and assured its development as a permanent fixture of the exhibition. In previous years the air show had been held in conjunction with the Toronto International Trade Fair, a government project canceled in this year's national budget. Its affiliation with the exhibition was in the nature of a trial.

Limited to Flying

Because the exhibition had already allocated all exhibit space before the affiliation, there was no room for static exhibits. Thus, the air show was limited to flying displays.

Plans are already being laid to allocate some space at nominal fees for static exhibits at next year's exhibition and air show. Exhibit space will be available to foreign as well as Canadian exhibitors.

More ambitious plans have been proposed for a permanent aviation building. Air show officials hope the exhibition management will be able to complete it in time for the 1958 show.

Besides this interest, both the Canadian aircraft industry and the military services are expected to increase their activity. The Aircraft Industry and Transport Association, representing aviation manufacturers and airlines, has played a minor role in the air show. Its officials now have assured air show officers that they are prepared to take a more active part.

Top staff officers of the Royal Canadian Air Force similarly are now prepared to put on a more dynamic display. They felt that the U. S. dominated this year's air show. In particular, they were chagrined at having the U. S. Navy put on the "obviously best show in the obviously best spot on the schedule"—the concluding act by the Blue Angel aerobatic team.

Most important to both AITA and the RCAF is the need to sell airpower harder.

There are many rumblings in the Canadian parliament, in part fostered by the Canadian army, against development of a Canadian aircraft industry and against putting a major share of the defense dollar into the RCAF. Development of the air show will seek to offset this threat through its demonstration of airpower to the Canadian public.

Next Year: CF-105

Next year's air show may be highlighted by the first public display of Avro Aircraft's 1,200-mph. CF-105 all-weather fighter. The first aircraft is scheduled for roll-out sometime next summer. Approximately 15,000 of the nearly 37,000 parts of the delta-wing airplane have been manufactured.

RAF's Hawker Hunters, canceled from this year's show because of the Suez crisis, have been promised for next year's program. France expects to send a larger representation of aircraft and equipment. Turkey has indicated that it would like to bring over its F-86 Sabre acrobatic team. West Germany plans some representation.

Besides the Blue Angel acrobatic demonstration and the flying display of the Fouga Magister trainer, highlights of this year's Canadian International Air Show included:

• **Demonstration of the de Havilland** Beaver and Otter amphibious light transports. The 1,000th Beaver is now on the production line and de Havilland's backlog is about 200 aircraft. Nearly 200 Otters have been built with at least another 160 firmly scheduled.

• **Record flight** of four U. S. Navy F9F-6s from Chicago to Toronto in 39 min. Average speed: 742 mph.

• **Flight of an** RCAF CF-100 all-weather fighter from Torbay, Newfoundland, to Toronto in 3 hr. 8 min. The distance is 1,294 mi.

• **Major showing** of the Royal Canadian Navy's recently acquired McDonnell Banshee all-weather fighters.

Other fly pasts were made by RCAF's T-33s, F-86s, CF-100s, C-119s and Coastal Command P2Vs; RCN's Grumman CS2Fs; USAF's F-86Ds, B-36, KC-97 refueling a B-47, F-94Cs, and F-89Hs.

In a straight flyby were several business aircraft: Acro Commander 680, de Havilland Heron, Royal Gull and Cessna's 310 and 182.

Russians Absent

Russians did not appear at the Canadian International Air Show, despite the interest that they expressed to Edgar Alberts, president of the Toronto Flying Club, at the Tushino flyby (AW July 2, p. 29).

In fact there wasn't a murmur from the Soviet Union about the Toronto show. The Russians are reported to have applied to Canada's Ministry of External Affairs for permission to be represented at a display in some other Canadian city in October. No display is scheduled for the time and place mentioned. Without explanation, Canada turned down the request.

News Digest

More than a third of Navy's Douglas F4D Skyrays, grounded early this month because of a defective afterburner mounting flange, were flying again at the end of last week. All should be back in service by end of next week.

Morane Saulnier MS. 760 Paris prototype completed first part of tests for American Certificate of Airworthiness. Second prototype now is going through ground tests for the same purpose.

Martin TM-61 Matador effectiveness will be increased in modification program. Air Force contract for work totals $4 million. New wing of three Matador groups is expected to go into operation in Europe this month.

USAF Airways & Air Communications Service will absorb USAF's Flight Service Oct. 1. Concentration of all airways guarding operations under one command will save $250,000 annually.

Lockheed P2V-7 Neptunes will be fitted with 16-ft. long, 5-ft. wide skis made of composite aluminum alloy and steel for service with Operation Deep-Freeze in the Antarctic. The four aircraft will have smaller ski attached to nose wheel as well as larger skis mounted on main gear.

Avro Vulcan bomber powered by four Bristol Olympus split-compressor turbojets flew 11,400 mi. from Britain to Australia in 23 hr., 9 min. flying time, averaging over 500 mph. Two stops were made, Aden and Singapore. Shortly after Vulcan left Aden, Russians jammed radio, knocking out communications over Indian Ocean several hours.

Special IATA Meeting Report:

Jet Orders Demand Airline Sales Push

Director General takes calm view of capacity implications but emphasizes breadth of increase.

By Robert Hotz

Edinburgh, Scotland—International airlines must go all out for the mass transportation market if they are to enter the coming jet age successfully, Sir William Hildred, director general, told the opening session of the twelfth annual general meeting of the International Air Transport Assn. here.

He warned airlines that the fleet of jet transports they have on order will exceed the present capacity of IATA members' 2,500-plane fleet by a wide margin and they must revise sales, operations, and rates to cope with the new era.

Sir William told IATA members that his forecast of future capacity of airline fleets falls about halfway between the prophets of disaster who feel that airlines have bought new capacity far beyond any foreseeable traffic rise and the optimists who look for a capacity shortage in 1960 and are warning that load factors will be rising uncomfortably high by then.

"The airlines have to begin now the hard work which will be necessary to make that forecast possible," he said. "One very important aspect of this work will be to consider the fare structure necessary to fill the new aircraft and keep the older types of aircraft busy for as long as they are required. Airlines must find out how to go all out for the mass market and recommend to governments a fare pared down to the lowest level consistent with sound economic operation."

Other Major Requirements

Among other major requirements for the jet age along with proper fare structure, Sir William cited:

• **Scheduling.** Cost of air travel in the future will depend in large measure on efficient utilization of jet transport fleets. This means airline travel must be made into round the clock operation, with night arrivals and departures accepted as normal procedure and provision of 24-hr. basis of airport facilities, customers, immigration and health services, transportation to and from terminals, availability of hotel facilities and ticket and information services at any time of day or night.

• **Navigation facilities.** Old concepts of air navigation, traffic control and sovereignty over national air space must be revised to cope with jet transport traffic. Sir William warned that it will no longer be feasible to use political boundary considerations for controlling high speed transports. He cited the recently revised ICAO navigation plan for the Caribbean region as a step in the right direction. This calls for specifying larger upper air control areas where high speed aircraft travel in contrast to smaller control areas for lower-flying short-range traffic.

"This is the type of broader handling of the issues involved in going beyond national boundaries and national prestige which will become essential in future planning of air traffic control systems in all other regions," Sir William said. "Allied to the unnatural and outmoded designation of airspace boundaries is the even more unreasonable practice which can only be termed a political expedient whereby control centers in different states share the responsibility for controlling aircraft in the same space. The only practical solution, naturally, is to establish a single center controlling the whole area and this must come from a realization that technical and operational considerations must take precedence over national prestige."

• **Ground handling.** Something has been missing in the coordination between those responsible for planning airport facilities and the airlines who must use them, according to Sir William. This has created the ground handling chaos that exists today and adds unnecessary time to air travel. He warned that the vital acceleration of ground handling procedures necessary for the jet age will come only from developing terminal buildings and ramps that are as modern and efficient as the jet transports they will have to serve.

Utilization of the current types of piston engine transports after jets become operational in large numbers is a serious technical and economic problem the airlines will face. Sir William also cited two great unknown factors in making accurate appraisal of the economics of the jet transport era:

Bristol 173 Tail Change

Bristol 173 helicopter displayed at Society of British Aircraft Constructor's show at Farnborough carried horizontal stabilizer and vertical fins. Previous configuration had V-shaped fins combination like Beechcraft Bonanza.

• **Existing restrictions** of tourist travel from Europe to America. He warned that means must be found to make the transatlantic tourist trade a two-way street.

• **Influence of fare structures** on traffic volume. He warned that major increases in traffic volume are not possible through small and frequent reductions in average fares per passenger-mile, but only through more substantial, if less frequent, changes in the basic fare structure and fare level.

Airline Achievements

Reviewing the economic health of international airlines, Sir William noted the following achievements during 1955:

• **Passenger traffic** showed an increase of 16% over 1954, with 68 million passengers carried 61 billion passenger-kilometers. Cargo showed a lively 18% boost to 1.3 billion ton-kilometers in contrast to increases below 10% for the past three years. Mail increased only 14% compared with 17% during 1954. Bright spot in the traffic picture for 1955 was the North Atlantic where nearly 700,000 people were carried for a 19% increase over 1954.

Sir William said figures for early months of 1956 indicated continuance of this increase and he forecast early attainment of a goal of carrying a million passengers a year across the Atlantic and surpassing the entire steamship capacity in this area.

• **Revenue of airlines** rose to $3 billion in 1955, an increase of 18% over 1954. About $2.3 billion or 78% of the total was accounted for by passenger traffic. Cargo brought in 11%—$330 million. Mail was 7%—$210 million dollars.

• **Operating profit** rose only $1 million, reaching $33 million for 1955. These figures reflect a new method of computation, eliminating money received as government subsidies. Figures for earlier years revised by this concept showed a $24 million operating profit for 1951, a $13 million loss for 1952, a $3 million loss for 1953, and a $32 million operating profit for 1954.

Sir William noted that primary profits of the airline business were made by lines operating in the domestic field and that international airlines were a long way from breaking even. As evidence he cited a $3 million loss of 30 international airlines for 1954 on total revenues of $1 billion.

Reply to Critics

Sir William lashed out at critics of IATA who have taken issue with IATA policies. Although not mentioned by name, his targets were readily recognized as the Civil Aeronautics Board and the Congressional subcommittee headed by Rep. Emmanuel Celler, (D.-N.Y.), who has charged that IATA is an international cartel. "It must be apparent to the dimmest of wits that IATA is not a cartel and that the international air transport industry is not made and could not be conditioned for that kind of control," he said. "No rapidly growing dynamic industry could be bound in the straitjacket of international monopoly, working under arrangements that are designed to keep down output and keep up prices. The only commodity whose price has come down steadily during the past 10 years is the airline ticket."

Sir William also warned against further attempts of the Universal Postal Union to cut air mail payments to airlines at its congress in Ottawa next July. He urged airlines to bring heavy pressure on their governments to force the congress to vote right on air mail payments or "you may as well reconcile yourselves to a loss of many millions of dollars."

ATC System Forces Change in Passenger Ticket Buying Habits

By Glenn Garrison

New York—Most of the nation's domestic airline passengers will have to change their ticket-buying habits under the industry-wide time limit plan going into effect this week. One major carrier estimates that 60% of its passengers formerly bought their tickets at the airport shortly before their flights departed.

The new Air Traffic Conference sponsored plan—effective date was Sept. 16—makes it mandatory that every passenger (with a few exceptions) buy his ticket at least six hours before departure in order to hold his reservation.

Heart of this first phase of the new campaign against no-shows and late cancelers is the ATC-prescribed deadline beyond which the carriers have agreed not to go in holding reservations. By and large, this deadline represents the major change in former reservations procedure. It sets 12:01 a.m. on the day of departure or six hours in advance of departure, whichever is earlier, as the minimum time limit for ticket pickup for reservations made before noon on the last business day before departure.

Most carriers will continue the practice of negotiating purchase deadlines with their customers, following guides set on a system-wide or local basis. All-important difference is that negotiation in almost all cases now ceases at the industry deadline.

Second Phase

Most airline officials expect the second and more stringent phase of the program, monetary penalties for late cancellation or failure to show up, to be inaugurated on schedule Feb. 1. Adoption requires 75% agreement by the carriers at a meeting in December, plus Civil Aeronautics Board approval.

The industry seems confident that few difficulties will be met in operating under the new rules, but the next three months are seen as a shakedown period during which public reaction to the deadline enforcement can be evaluated, and procedural details changed where necessary.

A few airlines will operate with stricter deadlines than required by the ATC resolution. Examples:

• **American Airlines** has set 6 p.m. on the day before departure as the final purchase deadline for reservations made before noon of that day. American will adhere to the 6 p.m. time limit generally, but can make exceptions up to the ATC minimum. Reservations made after noon on the last day before departure are not subject to the ATC requirement, but American will seek to negotiate a time limit two hours or more before departure in these cases. Failing this, passengers will be allowed to pick up their tickets at flight time.

• **Eastern Air Lines** previously had set and generally enforced, time limits, over about 80% of its system (and reconfirmation for Florida points and Atlantic City). These varying deadlines will be continued, but exceptions beyond the ATC minimum no longer will be made.

• **National Airlines** since June has generally enforced a requirement that tickets be picked up within 48 hr. after reservation is made if time permits. The arrangement will continue.

Airline personnel will continue to follow guides set up by their companies when negotiating purchase on reservations made well in advance. Starting point for all is the earliest convenient time for the customer.

Among the Big Four, American tries to secure pickup within three days after confirmation on reservations made more than two days before departure. Eastern asks pickup two weeks before departure when the reservation is made earlier than that time; if within two weeks, pickup at a convenient time the next day is decided locally. Trans World Airlines leaves the time limit scale to be decided at the district level. United Airline wants tickets picked up a week before departure on early reservations. United and TWA are not

going beyond the ATC deadline on late reservations.

First phase of the ATC plan will result in negligible cost to the carriers, according to their predictions, despite heavier initial workloads through longer conversations between agents and customers, changes in internal procedures, and widening of ticket purchasing facilities. No additional hiring is reported and none is expected to be necessary. Feeling is that the initial increase in workload will level off as reservations people and customers become accustomed to the new setup. Also, success of the plan automatically would mean less juggling of reservations and space.

Move Slowly

Airlines generally are moving slowly in establishing new ticket pickup points as suggested in the ATC resolution. Existing airline pickup facilities, travel agents' offices, delivery services, expanded use of mail plans and money order purchases are expected to take care of most customers' needs.

The bank depository plan, suggested in the resolution, is being used by at least one carrier, Southern Airways, with the service now in effect at 16 of Southern's 30 stations. Through this service, customers may pay for their tickets at certain banks, receiving receipts for presentation at the airport.

The ATC plan is something more of a problem, and less of an immediate advantage, for the short-haul carriers than for the bigger, long-haul airlines. The local carrier whose average haul may be under 100 mi. may find it more difficult to require its customers to take the trouble to pick up tickets in advance of flight time. Also, convenient pickup facilities at the smaller locations are apt to be less abundant.

Local carriers feel, though, that the plan will work to their advantage in the long run. A large percentage of the local service airline's no-shows may be passengers connecting with the trunk carriers. If the industry no-show problem is eased, therefore, the smaller lines will benefit too.

Airlines already have made considerable effort to convince the public that the new plan is for the customer's good as well as the carrier's. Advertising, letters to mailing lists, brochures to travel card holders, materials to travel agents have stressed the point. Replies to the letters so far have shown favorable reaction, according to airline sources.

Preparatory Job

Biggest preparatory job has been training of airline reservations people who bear the primary responsibility for selling the plan to the public.

For example, American estimates that each of its 3,500 reservations agents required seven hours of training and familiarization in the new system. This compares with an average of four to five hours per agent for most new procedures, according to the airline.

American's customer service manual concerning the procedures contains sample agent-passenger conversations to cover various time and personality negotiations under the new rules. One of them goes like this:

"On September 17, Mr. Stark secures a reservation on Flight 42 SFO-DCA, September 28:

Agent—" 'Mr. Stark, we will hold your reservation until 6 p.m., September 20. Can you purchase your ticket by that time?'

Mr. Stark—" 'No.'

"(Agent offers all available ticketing arrangements, none of which are acceptable to the customer.)"

Agent—" 'Mr. Stark, we can hold your reservation no longer than 6 P.M., September 27. Is that satisfactory?'

Mr. Stark—" 'No, I always get my ticket just before departure, so hold it for me.'

Agent—" 'Mr. Stark, in an effort to solve the no-show problem, all airlines require a ticket to be secured in advance. As you find it inconvenient to secure your confirmed ticket, it is impossible for us to hold this reservation for you. Reservations made after 12 noon the day before departure need not necessarily be supported by a confirmed ticket. That is the only time when passengers are not required to secure tickets in advance.'

Mr. Stark—" 'Let me speak to the manager.'

"(Agent calls supervisor.)"

American and the other carriers hope that Mr. Stark will represent a very small minority.

Eastern's Advertising Practices Criticized by Delta and National

Washington—Eastern Air Lines' advertising policy and lobbying efforts have been attacked by Delta Air Lines and National Airlines in complaints filed with the Civil Aeronautics Board.

Delta has accused Eastern of "unfair, deceptive and misleading" advertising practices in advertising its services as being "fastest" and at "lowest fares" on routes where the two airlines compete for traffic.

National complained of Eastern's "extrajudicial activity" in the Florida-Texas Service Case, accusing Eastern of trying to pressure the CAB into changing its mind about giving National a new Florida-Texas route.

Delta maintains Eastern is wrong in advertising its flights as "fastest" and its fares as "lowest" on routes where Delta's schedules and fares are identical.

In an exchange of letters between the two airlines, Eastern said the advertising is legitimate because no airline has lower fares on the routes in question —Houston-Washington-New York.

Delta vs. Eastern

The two carriers also exchanged words over their advertising of DC-7 services. Delta questioned Eastern's claims that its DC-7B Golden Falcon is the "newest, fastest, quietest" airliner. Delta cited the Convair 440 and Vickers Viscount to challenge the "quietest" label, and the DC-7C to challenge "newest" claims. And Delta pointed out that its DC-7s are scheduled for the same flight times as Eastern's DC-7Bs.

Eastern countered that the DC-7B is the newest transport in domestic service and pointed out that Delta has used the phrase "For Unsurpassed Speed" in its advertising and has advertised its DC-7s as "20 to 40 miles an hour faster than other types of airliners."

Delta said it withdrew advertising calling its DC-7 the newest transport when Eastern complained, but Delta maintained that it regards all DC-7 series as equal for advertising.

The CAB Office of Compliance is waiting for Eastern to answer Delta's charges before any action is taken.

The Compliance Office feels that there has been a general improvement in airline advertising practices in the past year, although some undesirable situations are not entirely cleared up.

National's Complaint

National's complaint, asking censure of Eastern came in a letter to CAB Chairman James R. Durfee.

The Board decided to give National a new route across the Gulf of Mexico from Florida to Houston in the Florida-Texas case. Under a new policy inaugurated with this case, the CAB announced its decision in a press release before issuing a final order and opinion. National said that Eastern is attempting to pressure the Board into changing its mind before the decision is made final.

As evidence, National sent Durfee copies of material Eastern is supposed to have distributed to employes at Miami and New Orleans in an effort to inspire political and civic pressure on the CAB in favor of Eastern.

National also accused Eastern of extrajudicial tactics in attempting to get the Houston Chamber of Commerce to take action favorable to Eastern.

CAB, SEC Continue Stock Leak Probe

Washington—Efforts by the Civil Aeronautics Board to determine who leaked the news of Northeast Airlines' new Florida-New York route to Wall Street have produced a CAB employe with some illegal stock last week, but the source of the leak is yet to be exposed.

Helping the CAB search for the source of the leak, the Securities and Exchange Commission found that Albert H. Ruppar, a Bureau of Air Operations trial attorney, bought Northeast stock in violation of Board rules. Ruppar has left the CAB.

When Ruppar's stock purchase was discovered, the CAB gave him five days to explain it. Five days later, the CAB issued a statement that, after a hearing on the matter, it had voted to discharge Ruppar and had accepted his resignation under Civil Service regulations.

Ruppar denies any connection with the leak, although he admits violating Board rules with his stock purchases. After its hearing, the CAB said its action was based upon Ruppar's purchase of 1,000 shares of Northeast stock on Aug. 3 in violation of CAB rules.

The Board said Ruppar had testified that he bought the stock on the advice of an account clerk in a Washington brokerage firm who told him of unusual activity in the stock on the morning of Aug 3, the day after the CAB decided to give Northeast the New York-Florida route in a closed meeting. The brokerage clerk corroborated Ruppar's testimony.

Ruppar denies he had any inside information and says he bought the stock strictly on the basis of the tip from the brokerage firm. He said he sold his Northeast stock after it sank below its original peak and lost money.

The Securities and Exchange Commission and CAB are continuing to investigate sudden activity in the stock right after the decision in favor of the New England airline, and the chairmen of the SEC and CAB have asked the Criminal Division of the Department of Justice to take an interest.

CAA Adopts Cure For Storm Clutter

Washington—Plans to circular polarize 47 radar installations to eliminate precipitation clutter were announced last week by the Civil Aeronautics Administration.

The program calls for circular polarization of airport surveillance radar (ASR) at existing locations and of equipment yet to be installed at other sites. The modification will enable controllers to continue operation of radar traffic control under most all weather conditions.

ASRs used by the CAA are presently vertically or horizontally polarized, and aircraft operating in storm conditions are often lost on the radar scope in rain or snow clutter.

ASR at LaGuardia was modified last June. Circular polarization of ASRs at Idlewild, Newark, Boston, Washington and Chicago (O'Hare) has been contracted for and the change-over will be completed by the end of the year. All six ASRs were circular polarized by Airport Instrument Laboratories.

Three types of ASR are covered by the program—ASR-3, manufactured by Bendix, and the latest type in CAA use; ASR-2 (General Electric), and ASR-1 (Gilfillan), installed in earlier programs.

Average cost to circular polarize each ASR already installed is $15,400 as compared with $5,000 for new equipment prior to installation.

Since five decibels are lost under circular polarization, ASRs will be "switchable" so controllers may return to vertical or horizontal polarization to get best possible readings in normal weather.

Experience of military services with circular polarization has demonstrated the effectiveness of the modification.

Circular polarization of ASRs is also scheduled for:

Atlanta, Baltimore, Buffalo, Burbank, Cleveland, Denver, Fort Worth, Knoxville, Long Beach, Los Angeles, Louisville, Nashville and San Antonio.

Also Anchorage, Birmingham, Charleston, Chicago (Midway), Colorado Springs, Columbus, Ohio; Covington, Ky.; Dallas, Detroit, Honolulu, Houston, Indianapolis, Jacksonville, Kansas City, Memphis, Miami, Milwaukee, Minneapolis, New Orleans, Norfolk, Oakland, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle and St. Louis.

Rails Ask End to Airline Subsidy

Washington—In a renewed attack against the air transport industry, the railroads last week revived their demands for repeal of the "need" provision of the Civil Aeronautics Act in order to put an end to airline subsidies.

The Assn. of American Railroads, in a booklet distributed primarily to schools and colleges, called for the adoption of airways user charges and an increase in airport fees to attain self-supporting airports. The booklet was co-authored by Burton Behling and Richard Blackwell of the association.

Behling told AVIATION WEEK that the publication did not necessarily mark the beginning of a new campaign against subsidies but was printed as a "public service" device on request of AAR field representatives.

The booklet declared that air transportation is no longer the "infant industry" of two decades ago but rather a "young giant come of age." The airlines' stand that subsidies should be paid until they reach "full maturity" was termed unsound on grounds that no growing industry ever arrives at full maturity.

The authors contended that, even without subsidy, the airlines benefit from military activities in the development of aviation. They cited the Boeing 707 jet transport as an example of aircraft development achieved by the expenditure of public funds.

The 707, the authors wrote, "is an adaptation of an Air Force tanker, and both will be constructed in the same government-owned plant."

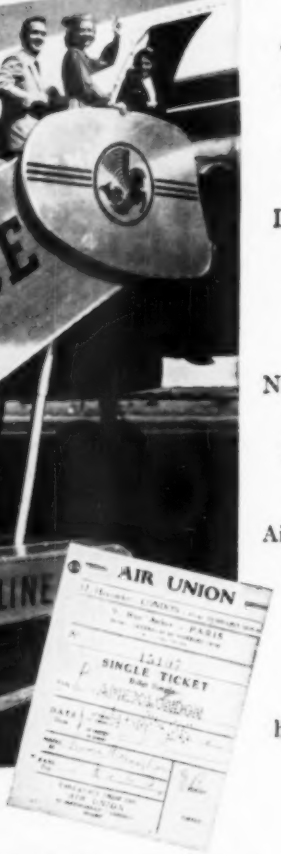
They also accused the airlines of enjoying scientific research sponsored and financially supported by the federal government through the National Advisory Committee for Aeronautics.

The booklet urges that domestic air transportation be forced "to demonstrate its own inherent potentialities for improvement and further growth in an economic environment of self support." Specifically, it called for:

- **Discontinuance** "once and for all the payment of subsidies to air carriers, which should be required henceforth to support themselves without further recourse to the public treasury." The booklet took issue with the separation of mail pay and subsidy and questioned whether all elements of subsidy had been eliminated by the plan. It scored the Civil Aeronautics Board for "bargaining" with the airlines to arrive at a mail rate agreeable to all parties. No stand was taken on the air movement of first-class mail, but these lower rates and air freight rates were compared with the higher allowances for air mail to suggest an element of subsidy within the service rates.
- **User charges to airlines** and civilian operators to help cover cost of airways and airport maintenance and operation. The report said the airlines are anxious to obtain even greater support for airways improvements as a way of reducing revenue losses incurred by delays and cancellations caused by air traffic congestion.
- **End of "preferential treatment"** to supplemental airlines. The booklet held that the railroads are placed at a disadvantage in competing for military traffic because irregular carriers are unrestricted by regulations and are aided by the Air Force in the "form of low-cost aircraft."

Then and Now . . .

A SATISFIED CUSTOMER FOR THIRTY YEARS



Mrs. Ridington's 1926 airline ticket.

Thirty years have brought radical changes in Air France equipment, but not in its reputation for dependability and comfort aloft.

Ask Mrs. Charles Ridington of Lansdale, Pa. In the picture above she is one of the group boarding a Farman "Goliath" in France prior to her flight to London. The date was July 4, 1926.

Now 30 years later, Mrs. Ridington will once again be an Air France passenger. This month she will be one of a group like those in the picture below boarding a giant Air France Super "G" Constellation enroute from New York to Paris.

Air France is proud of Mrs. Ridington's continued preference for its services. She is typical of those who have helped make Air France America's favorite European Airline.

OVER 4,000 PERSONS A DAY TRAVEL
TO 236 CITIES IN 73 COUNTRIES BY

AIR FRANCE

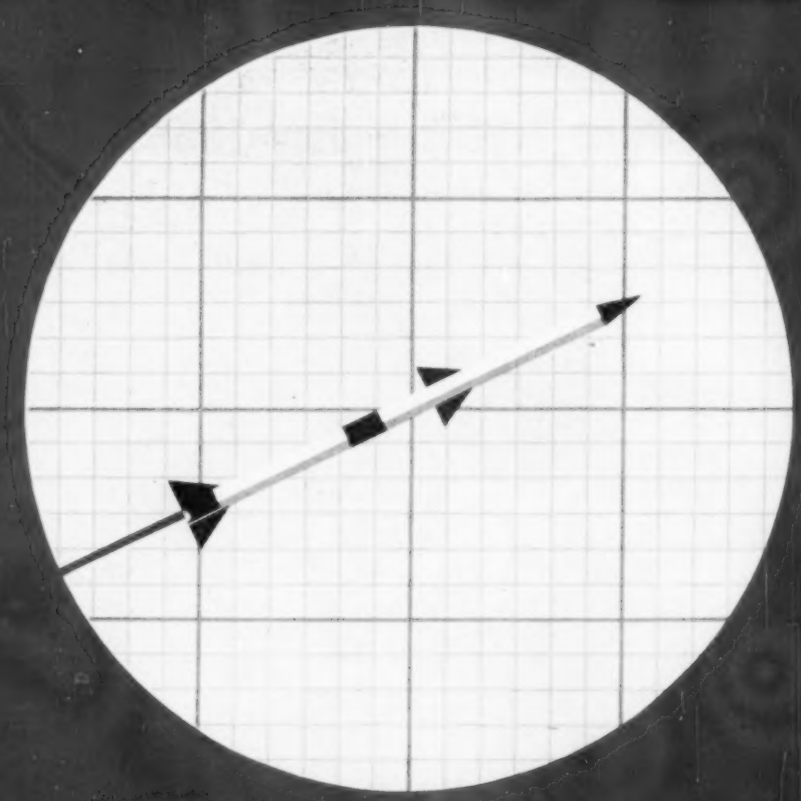
THE WORLD'S LARGEST AIRLINE
WITH 177,740 UNDUPLICATED ROUTE MILES

NEW YORK • ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • MIAMI • PHILADELPHIA • PITTSBURGH
SAN FRANCISCO • WASHINGTON, D. C. • MEXICO CITY • MONTREAL • TORONTO • VANCOUVER • HAVANA
PUERTO RICO • FORT DE FRANCE • POINTE A PITRE • PANAMA • CARACAS • BOGOTA

Airline Traffic—July 1956

	Revenue Passengers	Revenue Passenger-Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	634,616	428,328	66.49	1,493,716	720,811	5,426,748	48,537,532	56.95
Braniff	134,287	55,463	55.22	208,689	111,566	324,964	5,959,706	48.96
Capital	239,350	81,537	53.24	247,288	156,466	264,224	8,479,174	40.55
Continental	56,594	21,539	52.05	68,358	26,272	101,431	2,262,250	44.17
Delta	182,444	87,436	55.92	278,950	236,373	538,847	9,444,592	51.25
Eastern	585,810	291,780	57.01	822,126	370,837	1,069,898	31,806,831	44.84
National	105,678	72,160	66.79	215,610	39,490	358,370	7,951,755	64.26
Northeast	69,329	13,993	58.98	10,138	15,502	32,651	1,327,529	55.34
Northwest	116,138	82,633	61.85	372,076	190,899	642,812	9,303,848	52.62
Trans World	336,498	296,076	67.99	941,211	625,227	1,645,907	31,541,014	60.70
United	541,760	398,383	68.69	1,943,745	911,381	4,037,537	45,144,009	58.64
Western	97,574	50,518	59.84	208,728	78,447	150,266	5,266,098	52.43
INTERNATIONAL								
American	12,372	9,208	67.95	11,582	874	312,405	1,264,805	65.65
Braniff	2,974	6,399	54.34	22,973	.....	71,909	803,417	57.19
Caribbean Atlantic	16,515	1,152	63.79	1,007	.....	2,178	107,520	61.52
Delta	5,274	5,638	60.98	6,011	.....	36,151	623,031	48.20
Eastern	31,102	41,570	77.25	49,329	.....	72,900	4,525,955	69.27
National	10,526	5,176	54.70	8,991	4,494	27,118	567,606	49.98
Northwest	11,544	22,703	66.26	858,001	21,250	797,840	4,049,297	71.06
Pan American								
Alaska	9,127	9,339	72.93	39,850	.....	464,503	1,455,836	61.84
Atlantic	107,057	138,559	64.42	946,021	.....	1,729,250	16,954,057	59.85
Pacific	29,096	81,838	76.48	1,014,863	.....	1,206,370	10,653,092	71.58
Latin America	125,685	121,300	72.81	324,128	.....	3,044,540	14,633,436	65.57
Panagra	12,557	15,014	60.70	54,172	.....	307,885	1,951,309	58.46
Trans World	31,044	82,346	68.35	697,545	.....	755,603	9,970,384	69.87
United	12,189	30,258	84.20	96,446	.....	52,837	3,216,384	76.29
LOCAL SERVICE								
Allegheny	36,089	6,024	41.09	6,362	15,163	5,887	602,148	41.71
Bonanza	10,414	2,260	40.96	3,656	1,786	7,278	228,311	39.69
Central	8,003	1,531	31.50	3,487	1,655	5,974	157,420	28.34
Frontier	17,481	4,421	50.96	15,521	7,051	57,804	502,990	56.06
Lake Central	10,788	1,664	34.67	2,050	10,511	.....	162,954	33.08
Mohawk	27,120	4,900	47.60	5,053	6,670	8,585	488,572	47.50
North Central	51,255	8,388	52.01	18,021	25,962	.....	847,191	46.19
Ozark	26,481	4,096	33.42	9,539	16,244	7,163	415,594	34.39
Piedmont	36,207	6,904	51.89	13,411	12,191	8,968	695,033	51.27
Southern	15,565	2,759	41.46	7,962	13,179	.....	285,259	39.56
Southwest	26,173	5,112	48.90	7,582	4,457	7,821	506,492	47.23
Trans Texas	18,492	4,251	36.62	13,917	8,454	21,592	448,864	33.84
West Coast	19,445	3,305	44.01	3,576	1,979	5,453	309,764	43.92
HAWAIIAN								
Hawaiian	45,564	6,464	60.94	3,546	.....	113,761	673,654	57.29
Trans Pacific	23,770	3,041	55.60	701	.....	18,847	242,500	52.87
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	767,769	767,769	73.10
Flying Tiger	7,093	26,814	99.25	29,409	.....	32,047	6,912,997	78.51
Slick	5,440	27,222	90.66	82,469	42,985	3,880,535	6,728,152	74.46
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	6,580	34,906	100.00	.....	.....	1,124,258	4,614,957	89.40
HELICOPTER								
New York Airways	3,697	69	52.27	869	1,012	547	8,776	56.68
Los Angeles Airways	1,815	67	41.36	3,811	1,673	.....	11,672	49.91
Helicopter Air Service	.....	.....	.....	2,415	.....	.....	2,415	38.63
ALASKA								
Alaska Airlines	7,068	2,717	39.79	40,741	.....	617,893	966,647	51.56
Alaska Coast	6,357	588	65.63	3,605	.....	5,738	69,055	64.97
Cordova	2,088	354	58.90	2,620	.....	212,500	251,118	61.35
Ellis Air Lines	8,760	455	53.71	2,433	.....	2,527	50,930	59.34
Northern Consolidated*	.....	.....	.....	.....	.....	.....	.....	.....
Pacific Northern	14,356	11,304	65.13	73,661	.....	343,046	1,633,827	69.78
Reeve Aleutian*	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	5,441	2,237	13.42	30,024	.....	1,378,872	1,636,015	94.80

*Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



BALLISTIC MISSILES

on target a continent away through Burroughs computation

For some time, Burroughs has been participating in the U. S. Air Force Ballistic Missiles program in the field of guidance. This program consists of two intercontinental ballistic missiles: *Atlas* and *Titan*, plus an intermediate range missile, *Thor*.

Here's more proof that in its specialized areas of computation—instrumentation, control systems and data processing—Burroughs has what it takes to shoulder the overall responsibility for defense projects from beginning to end: (1) from research to development; (2) engineering and tooling; (3) production, testing, field service and training.

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The Todd Company, Inc., Rochester, N. Y.

Burroughs
The Foremost Name in Computation

Looking to future expansion, Burroughs invites inquiries from qualified engineers.

SAS Staggers Seats

Staggered seats will be introduced on Scandinavian Airlines System DC-7C North Atlantic Global Express flights this month and next month on Los Angeles to Copenhagen transpolar route. Design staggers seats 4½ in. from former three-abreast straight-line tourist configuration. Combined width of all seats is 5 ft., individual cushion width 18 in., and from top of cushion to floor is 19½ in.

CAB Revives C & S Rate Case

Washington—Civil Aeronautics Board has added a new twist to the celebrated Chicago and Southern Mail Rate Case by reopening the record for hearings on the airline's rate for international operations between Dec. 16, 1950, and July 31, 1952.

The Chicago and Southern case is the proceeding in which the Supreme Court issued its famous offset decision of 1954. The Court declared CAB policy in error and held that an airline's domestic excess profits should offset against subsidy needed for international operations.

The case covers C & S mail rates for the period Nov. 1, 1946, to July 31, 1952. In 1951, the CAB set a past period rate from Nov. 1, 1946, to December 15, 1950, and a future rate from there on. At that time, the Board followed a policy of not using excess domestic earnings to offset international subsidy.

The Postmaster General took the decision to court, and the Supreme Court found CAB policy in error and remanded the case to the Board for further action.

The remanded case was reviewed by the CAB, and a Board examiner found subsidy should be reduced by $700,000 of excess domestic earnings under the C & S rates set in 1951. Just before oral argument on the remanded case, the CAB raised the possibility of reopening the international rate for the 1950-52 period. Now the Board has decided to reopen that aspect of the case for review before a final decision is made on the whole proceeding.

Delta contended that the Board does not have the power to reopen the international rate, but the CAB rejects the airline's argument. The Board wants to review the rate in light of actual experience rather than the forecast on which it was originally based.

The CAB said refusal to review actual operating results during the period would leave C & S (now Delta) with a 36% return on investment for the period and over $1 million more subsidy that it could show a need for on the basis of operating experience.

Dissenters Gurney and Denny said it is their "firm belief and conviction that the Board as a matter of policy and as a matter of law should not reopen" the international rate issue. They added:

"We conclude that it is manifestly unfair to the carrier, to the investing public and to the carrier's creditors to review a rate which has been closed for approximately five years and which no party to the proceeding has challenged."

Ozark Recommended For Quad Cities Route

Washington—Ozark Air Lines last week won support of a Civil Aeronautics Board examiner for its route bid in the Quad Cities-Twin Cities Case.

Ozark was favored to operate a new route between Davenport, Iowa-Moline, Ill., and Minneapolis-St. Paul, Minn., via Cedar Rapids, Iowa, and Rochester, Minn. Examiner Joseph L. Fitzmaurice recommended that Ozark be allowed to operate the route for three years or until 60 days after decision in the Seven States case, whichever comes first.

Fitzmaurice said the choice between Ozark and North Central Airlines, the two applicants, was difficult, but he found that the route integrates better with Ozark's system. The examiner said Ozark would provide more new one-carrier service and generate more connecting traffic than would North Central.

Bad Approach Blamed In Eastern Crash

Washington—Civil Aeronautics Board has decided that an Eastern Air Lines Constellation crashed at Jacksonville, Fla., last December because the pilot applied power for a missed approach too late to avoid ground obstructions.

The accident occurred at 3:43 a.m. on Dec. 21 when Miami-Boston Flight 642 was on final approach for a scheduled stop at Jacksonville.

The approach was made in foggy weather with a 300 ft. ceiling and half-mile visibility, and the Constellation crashed about .6 mile from the runway, killing the crew of five and all 12 passengers.

The CAB found evidence that power had been applied just before the crash and said probable cause of the accident was that a missed approach procedure came too late to prevent the aircraft from hitting some trees.

Reports of military jet aircraft flying very low over the Jacksonville airport at the time of the crash were investigated by the Board, but it was concluded that no such aircraft were in the vicinity at the time.

SHORTLINES

► **British European Airways** will begin flying to Dublin under a new agreement signed with Aer Lingus. BEA will start London-Dublin, Birmingham-Dublin and Manchester-Dublin services in April, and Aer Lingus will have rights to operate between Dublin and

Advantages of the

ROLLS-ROYCE

CONWAY

BY-PASS TURBO JET

for long range airliners

*

Lower weight giving increased payload

Lower guaranteed specific fuel consumption

Lower first cost and operating costs

Less noise

*

ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

Brussels, Frankfurt, Dusseldorf, Amsterdam, Zurich and Rome via Manchester. BEA's capital investment in Aer Lingus has been cut from 40% to 10%, but Lord Douglas, BEA chairman, will remain on the board of directors of the Irish airlines.

► **Bolivia** has purchased eight B-17s for the use of the government and the Bolivian Development Corp. The bombers will be reconditioned in Bolivia and used to transport food and other goods within the country.

► **Capital Airlines** inaugurated four new Viscount flights last week between New York and Chicago. All four flights are nonstops scheduled for 2 hr., 50 min. Capital now has 35 Viscounts.

► **International Air Transport Assn.** has produced three new symbolic labels to be used for marking perishable or fragile cargo after Oct. 1. The pictorial labels are part of a standardization program now under way. New labels for marking dangerous items were introduced earlier this year.

► **Lufthansa** opens a new route to Teheran this week and plans to extend the route to Tokyo by 1961.

► **Mohawk Airlines** has inaugurated service to Glens Falls, N. Y., with two round trips daily connecting the city with Boston, Syracuse, Rochester, Buffalo and other northeastern points.

► **North Central Airlines** claims a local airline passenger record with 56,467 passengers boarded in August.

► **Singapore's airport traffic** increased 38% in the first half of the year and is expected to total more than 300,000 persons for the full year.

► **Soviet Union** has asked permission for Aeroflot to fly over West Germany when it opens new routes to West European cities. Such permission must come from Britain, France and the United States under terms of the German peace treaty.

► **Swissair** is doubling the size of its New York reservations department to handle increased transatlantic traffic. . . . Swissair carried 88,861 passengers in July, 15% more than last year.

► **Tokyo International Airport** will be improved in a $15.8 million government program designed to prepare the field for jet operations. A new 10,000 ft. runway will be in operation by 1960, and present 8,000 ft. runways will be lengthened 1,000 ft. Tokyo also will get new control tower equipment and parking facilities.

AIRLINE OBSERVER

► **Sncase will bring its twin-jet Caravelle airline to the U. S. about May 1 for a tour which may last two to three months. It will visit the main bases of all major airlines. The first three production airplanes will be delivered to Air France in 1958 and probably will be placed in passenger service on Air France routes in the Caribbean. By that time the French airline may have completed its arrangements for service out of Miami to its possessions in the area. Nine Caravelles are scheduled for delivery in 1959. In 1960, Sncase plans to turn out four aircraft per month. If orders are sufficient, it will double this amount. Should the Caravelle attract a large number of orders, Sncase has arranged with Republic Aviation Corp. for the establishment of a second production line in the U. S. with a capacity of up to seven aircraft per month.**

► United, Northwest and Northeast Airlines are reportedly interested in the Convair 880 medium-range jet transport and at least one of the companies may place a sizable order within 60 days. Northeast's interest in the Bristol Britannia turboprop has not dwindled (AW Sept. 10, p. 47). George Gardner, the airline's president, called a special meeting of his key executives immediately after his return from an eight-day trip to England to allow them to evaluate his "many impressions" of his visit with the Bristol people which, he said, he found "interesting and enlightening." Gardner emphasized, however, that no commitments were made during the trip.

► **Convair 880 jet transport will sell for $3,650,000 including reverse thrust and engine silencer. If 880 sales reach 250 aircraft, Convair plans an across-the-board rebate to purchasers that will bring the cost down to $3 million.**

► Lockheed Aircraft is launching a full-scale drive to expand the market for its 1049G, 1049H and 1649A transports. Company's top sales officials are convinced there is a big potential for high-performance, piston-engine transports despite the coming of turbojets and turboprops.

► **Capital Airlines estimates the Rolls-Royce Avon 29 turbojet engine powering the Comet IV will have logged one million hours by the time the first Comet on Capital's order is delivered.**

► Two new turboprop transports are under development in England. Armstrong-Whitworth has started work on two prototypes of a medium-sized, twin-engine turboprop for combined freight-passenger operation and Scottish Aviation is developing a 40-passenger turboprop version of its Twin Pioneer.

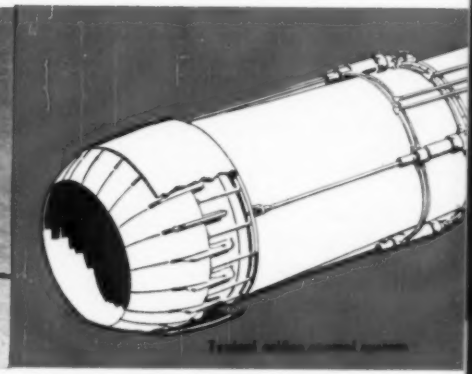
► **Ansett Airways and Butler Air Transport, rival domestic operators in Australia, are planning a merger that will bring an end to the one-year-old rate war (AW Sept. 3, p. 47). It is understood that the proposed merger is strongly opposed by Australian National Airways. ANA, already a large stockholder in Butler, may seek a majority voting right by buying more shares in hopes of killing merger negotiations.**

► Air Traffic Control Assn., representing approximately 2,000 controllers, has challenged the Civil Aeronautics Administration to deny or confirm a Civil Service Commission statement by chairman Philip Young that the CAA has agreed to a CSC program on controller standards that may result in the downgrading of some personnel (AW Aug. 27, p. 30). ATCA says its members were led to believe that the CAA had opposed the standards which formally went into effect Sept. 1. No action has been taken, however, pending CAA-CSC review.

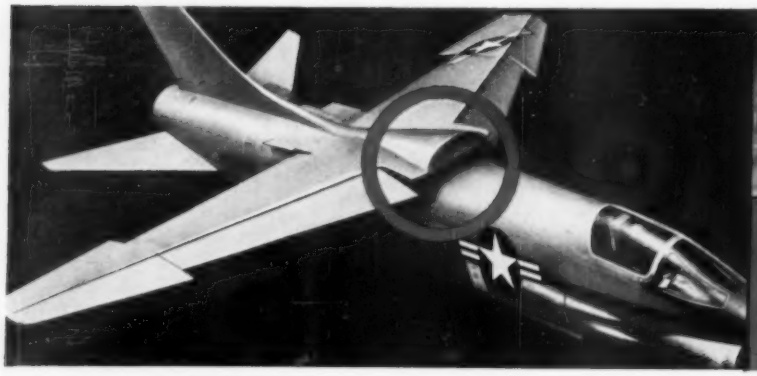
► **Acting Civil Aeronautics Administrator James Pyle has announced his intention of continuing policies and programs of the late Charles Lowen without change. Lowen died on Sept. 5 (AW Sept. 10, p. 41).**

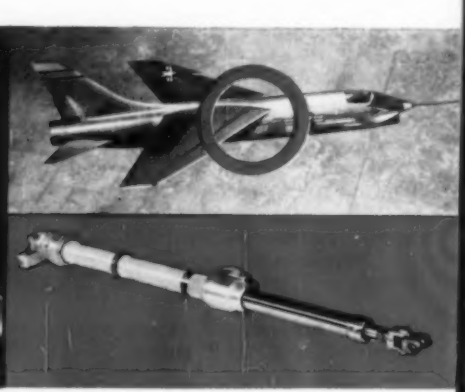
► Two Civil Aeronautics Administration officials are in Europe to study production and technical matters with the Lorenz Co. of Germany, manufacturers of VOR units that will be installed on international routes under the jurisdiction of International Cooperation Administration.

Vital accessories for the fastest fighters

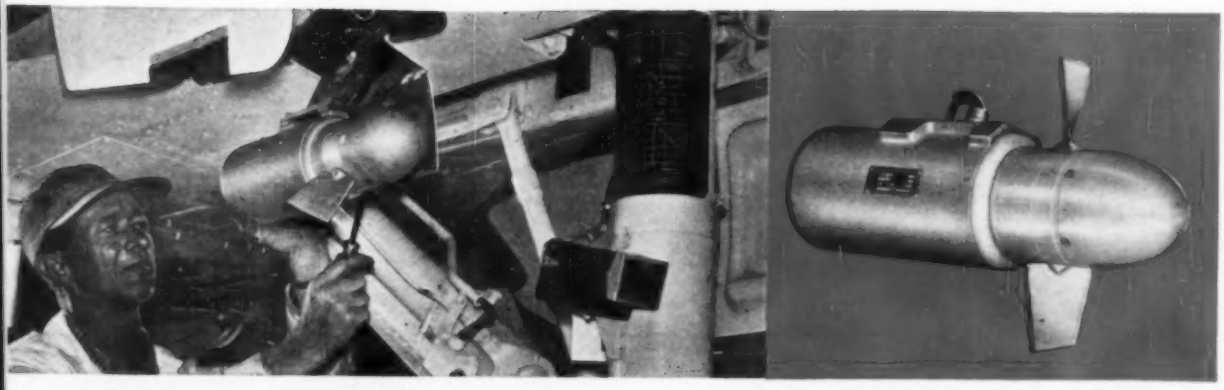


AFTERBURNER ACTUATORS – *the Lockheed F-104A Starfighter,* world's fastest fighter plane, has four Aeroproducts actuators on the afterburner for orifice control of its J79 engine. Designed for extremely high temperature operation, these hydraulic actuators are synchronized to co-ordinate in perfect unison, providing instant, positive control of the afterburner nozzles. This patented feature of mechanical synchronization provides precision positioning by incorporating flexible shafting within the hydraulic tubing to co-ordinate the linear travel of the actuator pistons. Another safety factor is a stroke limiter which prevents the tail cone from closing completely in the event of hydraulic failure.

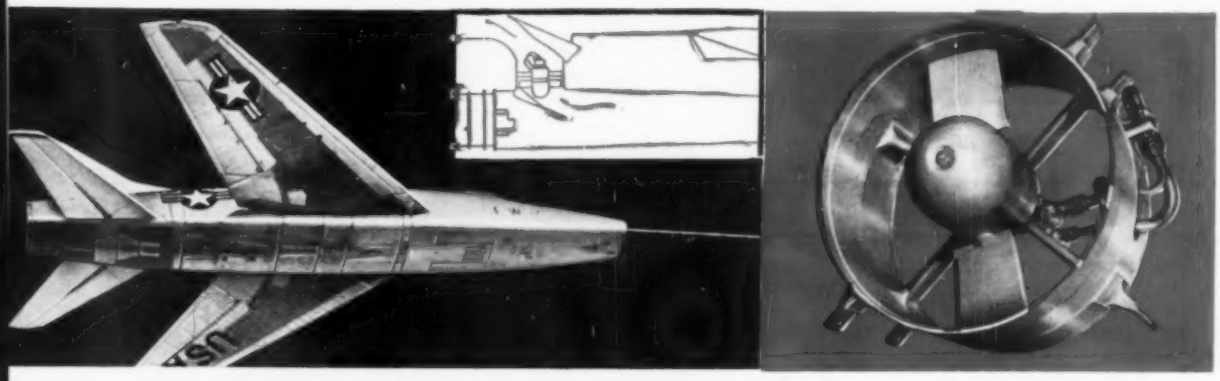




WING INCIDENCE ACTUATORS – *the Chance Vought F8U-1 Crusader,* world's fastest Navy fighter plane, showing its unique two-position incidence wing in "up" position for take-off. Inset shows normal flight position. First operational plane to incorporate this principle, the F8U-1 has an Aeroproducts self-locking hydraulic actuator which controls the angle of attack of the wing. Changing the wing angle permits the Crusader to land level with the runway of the carrier deck, giving the pilot better visibility and permitting use of shorter, lighter landing gear.



RAM AIR-DRIVEN GENERATORS – *in the Douglas A4D Skyhawk* – Aeroproducts emergency air-driven generator is first production application of ram air-driven equipment. Suspended beneath the fuselage, this lightweight unit (22 lbs.) gets up to speed in less than 1/10th second and develops 1.7 KVA @12,000 R.P.M. to operate radio, lights, instruments, trim tab and elevators. It has successfully performed in emergencies and has been dropped out many times on flight tests. Using a simple blade pitch changing mechanism, the unit governs its output frequency within plus 10% and minus 5% over a very wide range of airspeed, altitude and load conditions. This unit also has application in tow targets to generate power for scoring mechanisms.



AIR-DRIVEN HYDRAULIC PUMP – *the North American F-100D Super Sabre* is equipped with an Aeroproducts air-driven hydraulic pump which produces sufficient hydraulic pressure for flight controls in case of either engine or hydraulic failure. This lightweight ram air pump is mounted back of the cockpit, where air from engine air inlet ducts can be directed by the pilot to drive the turbine-pump in emergencies.

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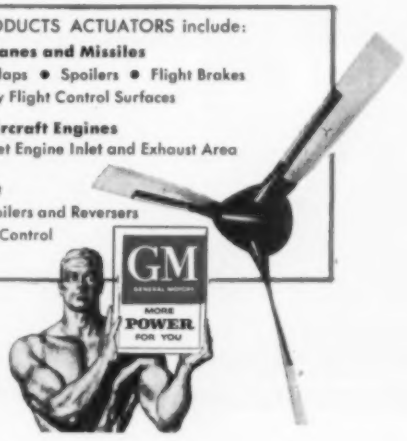

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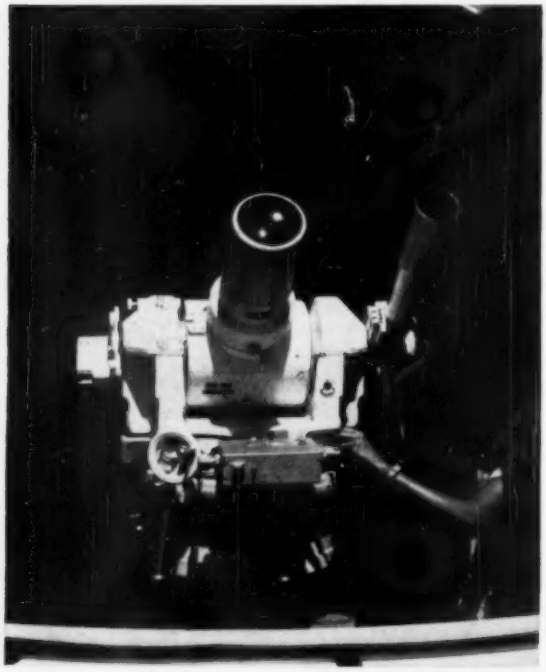
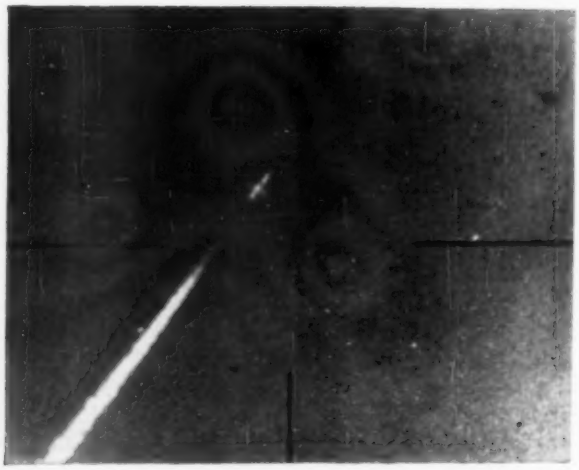
Cameras Track Crusader

Chance Vought F8U Crusader, ready for takeoff on ramp at Naval Ordnance Test Station, China Lake, Calif., (top) was timed by two Bowen cameras (bottom right) at southern end of course for Thompson speed run. One of eight Askania cameras (bottom left), tower-mounted as auxiliaries, caught the F8U (right) in the 1,015.428 mph. run. Azimuth, elevation marks make course measurement possible.





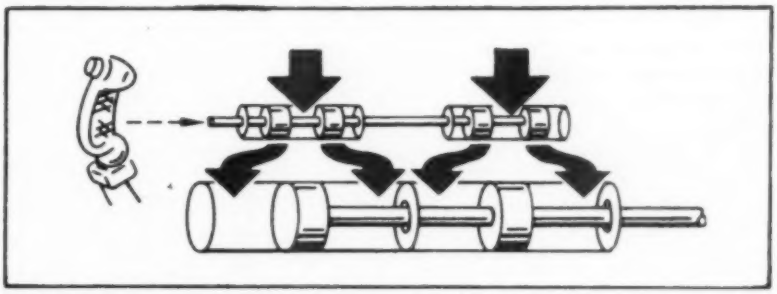
Republic Turns to Dual Actuator Controls

By Robert H. Cushman

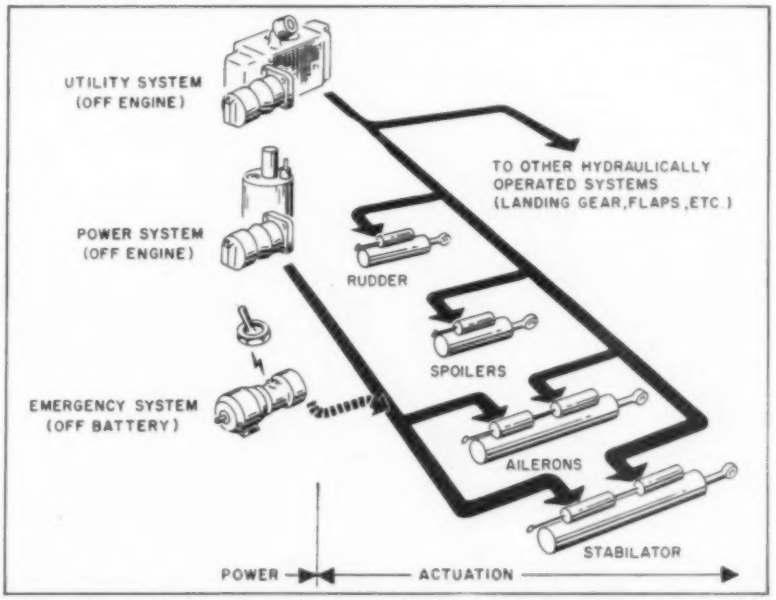
Farmingdale, N. Y.—Republic Aviation is retrofitting approximately 1,500 F-84Fs with a simplified control actuator system and is planning to use an advanced version of this new system in its forthcoming F-105 fighter-bomber.

The system is called a tandem actuator system because during normal operation it uses two independent hydraulic loops working side by side on the same control surfaces. Stick movements cause both systems to act in unison to make the control surfaces respond.

Both halves are sized so that they are capable of carrying the primary control-surfaces alone.



REPUBLIC'S new control system is built around tandem actuators for the main surfaces. These actuators are composed of two separate servo valve and piston units but with both servo valves and pistons on the same shafts to insure continuous synchronization. Normally both sides are working, but each has the capacity to handle most of the load alone.



TWO HALVES of the most important controls, stabilator and ailerons, are powered by two independent hydraulic loops. One is the power system which is for the stabilator and aileron only. The other is fed from the airplane's general utility system and feeds the rudder boost and the high speed roll spoilers as well.

Automatic Safety

Advantage of this system from the pilot's viewpoint is that he doesn't have to do anything upon the failure of one of the systems since a stand-by system, in effect, is already in action and automatically in phase.

Advantages can also breed problems. In this case the problem was to insure that the two systems were really working in synchronization so that failure of one would mean only that the other smoothly continued to translate pilot control movements into control surface deflections without any momentary loss of continuity.

The tandemizing has been accomplished by putting both the servo valves and the servo actuating pistons on the same shafts. Thus they are always mechanically in step. Other means of synchronizing tandem systems are possible (for example North American uses a tandem system without direct mechanical connection on its F-100) but the virtue of Republic's system is that synchronization is built in permanently upon manufacture and no further adjustments in the field are necessary.

Simplicity Gained

"The most noticeable aspect of the tandem actuator system is its simplicity as compared to the original system," William I. Stieglitz, Republic design safety engineer, said. "Approximately 52 components including valves, switches and relays have been eliminated in addition to numerous lines and fittings. This results in greatly simplified maintenance, greater reliability and ease of operation."

There is one-fourth less maintenance on the tandem system, Republic Liaison Engineer Larry Levine estimates, for there is very little to do except put the oil in.

Check outs are positive; the system either works or it doesn't. There is a minimum of check-out ritual and evaluation to delay takeoff and tax the pilot's judgment, as compared to the previous Republic system.

Bonus of 125-130 lbs. weight saved goes along with the simplicity.

All electric components have been eliminated except for the motor driving an emergency hydraulic pump and one single-throw on-off switch to energize this motor. Power and utility systems have been made completely independent, with each system supplying fluid to one-half of the tandem actuators on the stabilator and aileron. Rudder and spoilers are operated by single cylinders connected to the utility system.

In the F-84F the stabilator and ailerons are designated as primary controls—the minimum needed to fly the airplane. The spoilers were added as an afterthought to increase high speed combat roll rate. The pilot has no difficulty in using the rudder, especi-

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FIG. 1

The relative motion between the inner and outer Gerotor teeth causes the oil chamber to be variable – slowly opening to maximum as it passes the inlet port – slowly closing as it passes the outlet (See Figure 2). This makes for a steady relatively pulseless flow – regardless of outside pressure changes. Thus, turbulence is minimized and foaming is avoided, efficient pumping being maintained at all altitudes.

FIG. 2

▸ **Gerotor pumps are simple** and compact in design, valveless and have high volumetric efficiency due to the fluid-tight engagement of the Gerotors which maintain high suction at high pressure. Further, this continuous contact pressure is maintained for life because of the hunting tooth principle.

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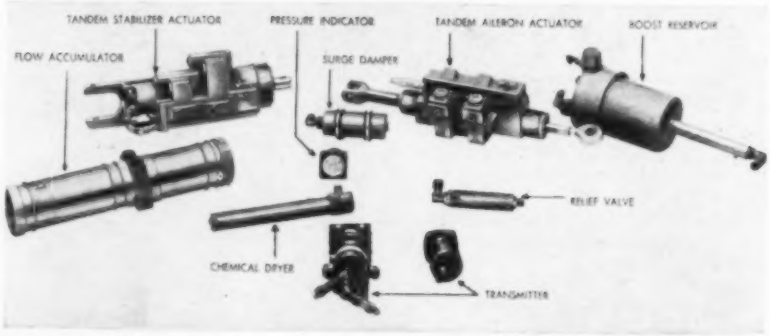


GAIN IN SIMPLICITY is shown by comparing old (top) and new system components.

ally during landing when the rudder is needed most.

The stabilator actuator is so designed that each half of the tandem cylinder has 95% of the capacity of the complete actuator. Except in the most severe maneuvers, failure of one system will have no noticeable effect on the longitudinal control of the airplane. Furthermore this limitation will only affect the amount of control deflection, as governed by the hinge moment, and will not affect the rate of control surface movement in normal maneuvers involving moderate hinge moments.

In the aileron actuator, each half of the cylinder has only 50% of the load output of the old system so a reduction in aileron control power will be experienced if one system fails; however, this loss of control capacity will merely limit the performance of maneuvers requiring maximum aileron hinge moments. There will be no change in control forces or in the rate of deflection at low hinge moments.

Last Ditch

Because of the complete independence of the two systems, no single hydraulic failure can result in the loss of both systems.

The only single occurrence which can have this result is engine seizure (or to a much less drastic extent, engine flame out). For a last ditch case there is an emergency hydraulic pump, powered by an electric motor and tied into the boost system. In the interest of simplicity and to eliminate the need for pressure switches, transfer valves, etc., there is no automatic take-over.

The emergency system must be turned on by means of a switch on the pilot's left console.

Because the control valves block the fluid in both sides of the actuator cylinder, a loss of hydraulic pressure resulting from engine seizure will not permit the surfaces to move as long as the control stick is not moved. Therefore the emergency pump must be turned on following engine seizure before any control manipulation is attempted.

If the control stick were moved too much before the pump was turned on, the oil pressure trapped in the air-charged accumulator would be lost and

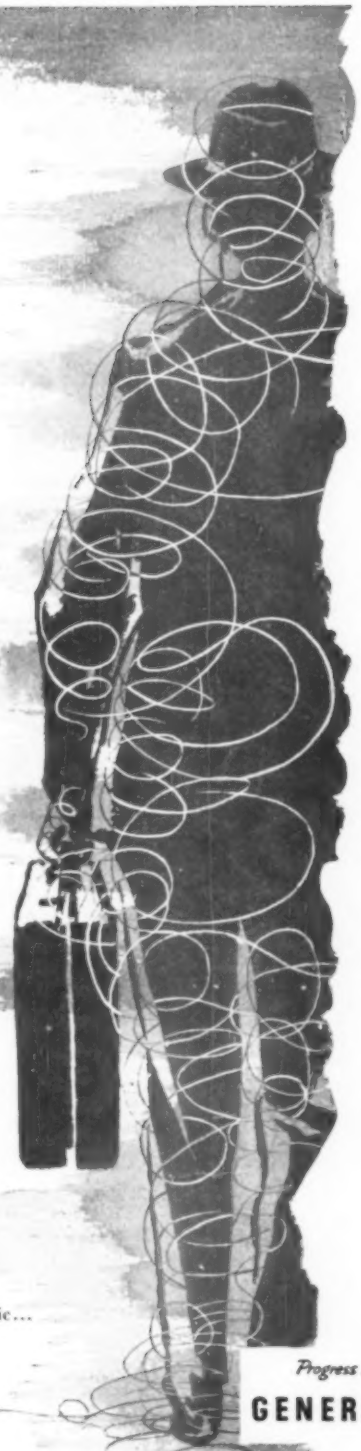
Pilot's Comments

Lin Hendricks, Republic test pilot, who first flew the tandem system Oct. 20, 1955, said the plane seemed easier to fly. Although the artificial feel was adjusted to the same forces as the previous system, the flying forces seemed lighter.

Jack Bade, Republic's assistant director of flight operations, later landed an F-84F on each of the three combinations and could find no difference.

Republic says that Air Force pilots who have flown the F84F with the tandem system agree that no difference in flight control response can be noticed regardless of which hydraulic system is operating.

have competence will travel



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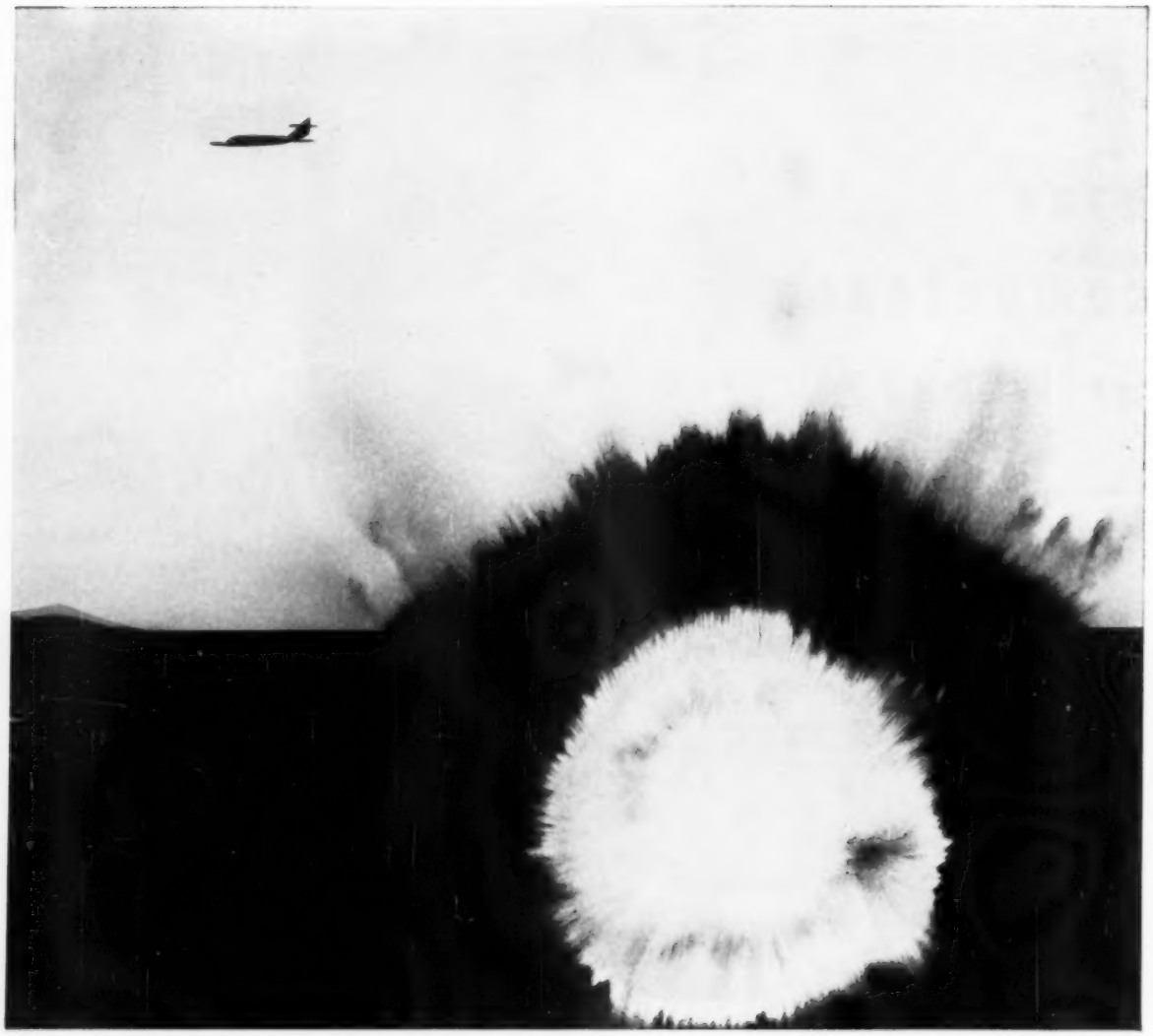

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the previously irreversible control surfaces would be "free." The pilot might find himself in an uncontrolled maneuver without engine thrust before he had a chance to turn on the emergency pump. However, a flight check of this possibility indicated that there was enough time either to turn on the emergency electric pump or to eject.

The electrically driven emergency pump has the same capacity as that in the original installation so there will be the same degree of control. It is actually possible to fly combat on the emergency pump, Republic engineers say.

The F-105 goes one step further in emergency system simplicity and has the pilot work a lever to push a ram-air turbine out in the airstream from the side of the plane to drive the emergency pump. Instead of half of the tandem system tying into the utility circuit, the F-105 has two independent power circuits.

Tandem Drawbacks

A price must be paid for this simplicity. One part of the price is that since the emergency system is tied into the main power system through a check valve, a line failure in the power half of the main tandem system will result in loss of the emergency system as well.

Another part of the price to be paid is the higher machining tolerances that must be held. Servo spool valves have always required a very high grade of machining. Keeping the dimension of a long dual servo valve so that both systems will really work together presents an even greater problem,

Sea Venom Pull-Up

Aerobatic team of Royal Navy Fleet Air Arm Squadron 890 flies straight up in Mark 21 Sea Venom fighters, Lt. Cmdr. P. G. Young, squadron commander, is team leader. Besides checkerboard tip tanks, planes are marked with witch on flying broom insignia.

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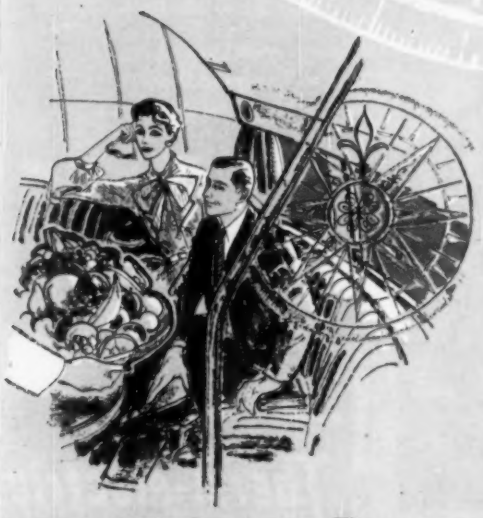

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Honeycomb

Convair at Fort Worth, Tex., is making stainless steel honeycomb on its own machine (left) for cores of sandwich panels in B-58 primary structures. Boeing Airplane Co., workers at Seattle (right) are about to mill a contour on a honeycomb that has been fixtured by being frozen in water. Long appreciated as an ideal way to brace aerodynamic skins while integrating them into monocoque structures, honeycomb has not had wider use because of the difficulties of fabricating, machining and fastening in volume production. Both adhesive bonding (Convair says it has had success with Shell 422-J epoxy-phenolic adhesive) and metal brazing are used to join the honeycomb to the skin. Growing importance of honeycomb can be judged from increasing number of airframe subcontractors who are incorporating it into production lines. For example, Aeronca Manufacturing Corp., Middletown, Ohio, has recently installed both metal brazing ovens and adhesive bonding platens.

Ozone Metals, the Long Island firm that has produced much of the development hardware, has found.

After building 275 F-84Fs, Republic decided that the Thunderstreaks needed all-moving stabilators substituted for their original marginal elevators for adequate high-altitude combat maneuverability.

The change to stabilator meant that the F-84F was unavoidably saddled with a 100% hydraulic link between the pilot and the control surface. (Obviously it was now out of the question to ask a pilot to manhandle the pitch control.) Consequently Republic found itself adding safety circuit to safety device to avoid making the pilot dependent on any one mechanical unit without alternatives in case of failure.

Two years ago it reached the point where there were three panic buttons for the pilot to choose in case of control system failures.

"Small wonder," Hydraulics Engineer Herb Quartin said "that with the plane acting and sounding funny and a couple of the warning lights on, the pilot would dimly recall the service manual and punch out a few quick guesses on our three buttons. Then after thoroughly lousing himself up, he would hit the 'eject' button."

The germinal work on the tandem system came from the hydraulic staff research group. In effect, the group decided to obtain more positive reliability by having two completely redundant systems continuously operating in parallel rather than item by item alternatives with complicated electro-mechanical interlocks between a maze of dependent systems.

Retrofitting the 1,500 F-84Fs is under way at Mobile and Ogden Air Force Depots. It is estimated that it will take 1,600 man-hours per aircraft using at least 8-man crews to carry out the authorizing Tech. Order (T.O. 1F-84-571) with its 40 pages of parts lists. This work includes removing all hydraulic components and tubing of the previous system in the aft fuselage, approximately 75% of all the hydraulic components and tubing in the engine compartment, approximately 25% in the forward fuselage, and the installation of all new components, fittings and tubing in these sections of the aircraft.

Australians Still Want to Build Lockheed F-104

Reports in British and Australian press that Australian government and RAAF are cooling toward plans to produce the Lockheed F-104A in Australia under license were denied to AVIATION WEEK. Reports said British pressure was brought on Australians to substitute a British fighter, possibly the P-1 of English Electric. Australians, however, are continuing negotiations to manufacture the F-104A.

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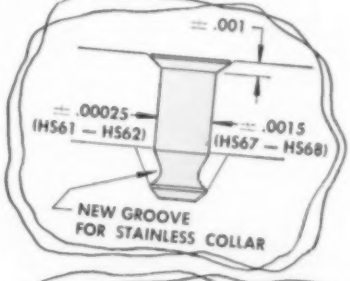

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Above is a close-up view of a Cecostamp producing a panel of cold rolled steel.

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Stampings shown above are for aircraft and automotive use, made from a variety of metals and alloys.

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Test Firing

Rig at Holloman Air Development Center for testing Convair F-102 missile firing system. Note photo of belly of F-102 has been retouched to erase missile bay doors. Plane carries six Hughes Falcon air-to-air missiles. Test firing also is done in air at target drones over 128-mi. Holloman range.

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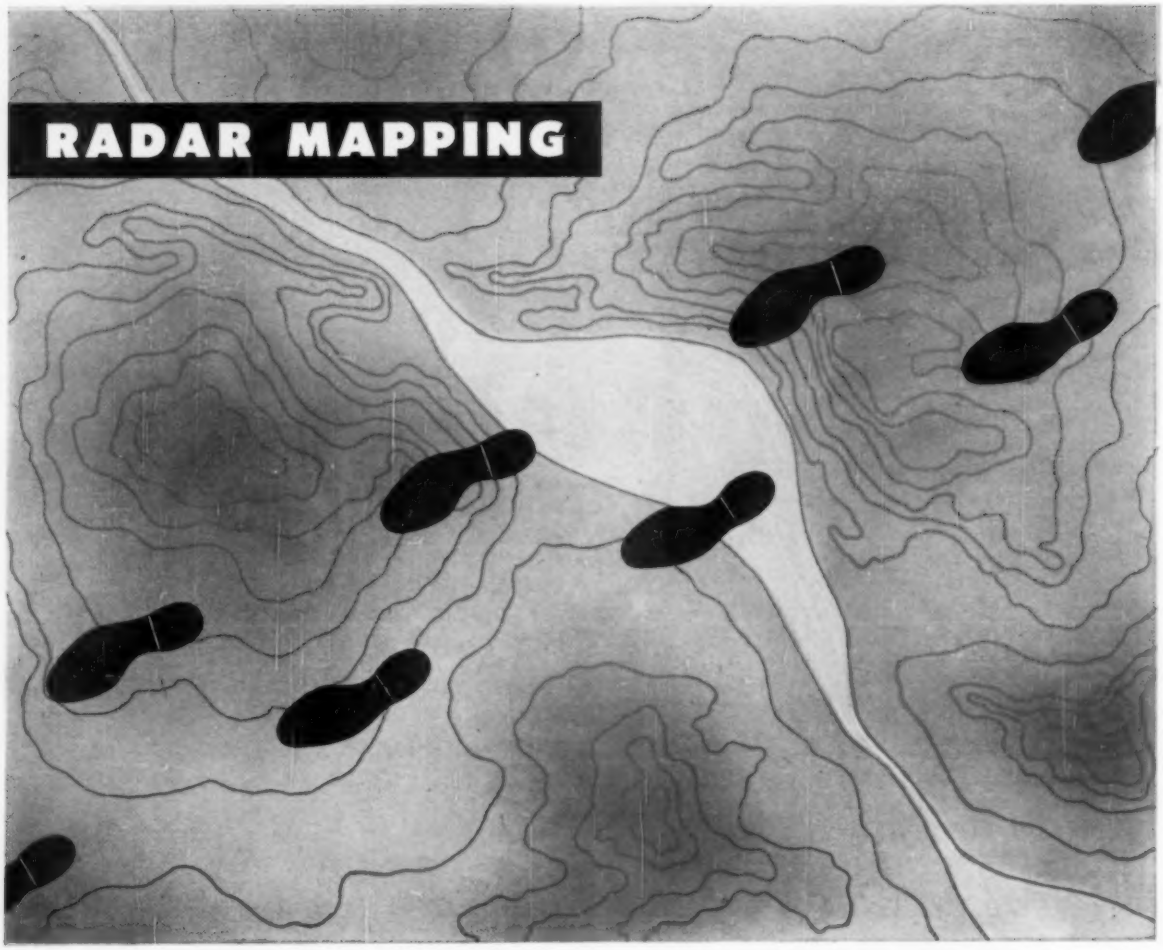

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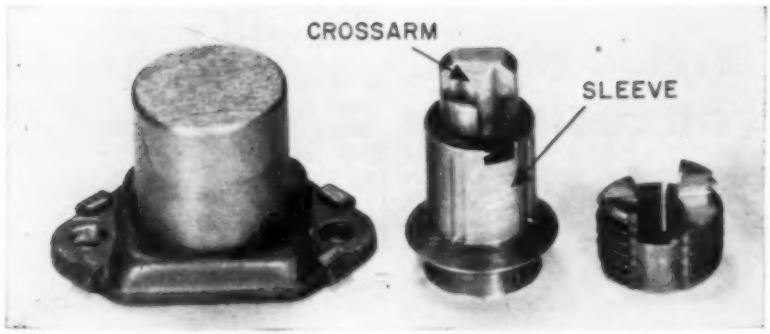
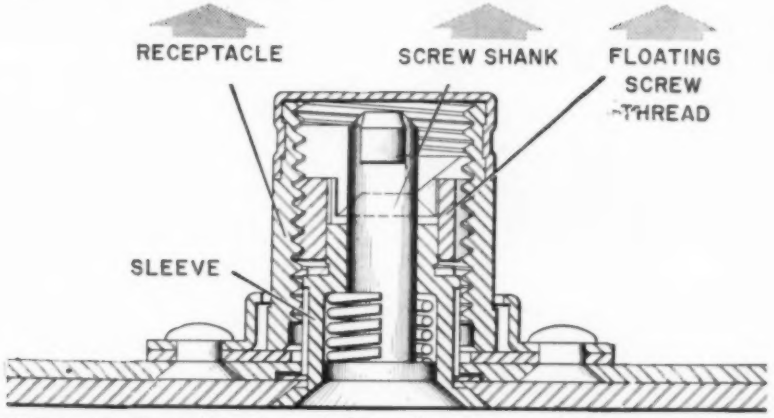




THREE main subassemblies of new high-strength fastener: receptacle, screw shank, and floating thread element. Top photo shows the separate subassemblies and bottom drawing shows a section cut through the complete fastener. Noticeable feature of the sample, excepting one retaining ring, is the husky quality of the parts.

High-Strength Fastener Developed For High-Performance Aircraft

A new high-strength quick-operating fastener has been designed by Victor F. Zahodiakin, Summit, N. J. The manufacturer asserts that his fastener combines the strength and clamping action of an aircraft bolt with the quick action of a quarter-turn panel fastener.

The inventor said the development of the fastener had been prompted by the growing need for a superior strength joining device to unite access panels structurally into the stressed skin of high performance aircraft.

Clamping Action

The need is for a fastener which possesses the clamping action and self-locking ability of a permanent fastener. But it also must be capable of being expeditiously removed and replaced many times without losing these qualities. Added obstacle to a successful design is the likelihood that the fastener will be subjected to 700-800F temperatures due high-Mach number aircraft.

Zahodiakin has achieved these requirements by using a two part screw. Upon removal the head and shank come out of the receptacle but the screw thread remains behind.

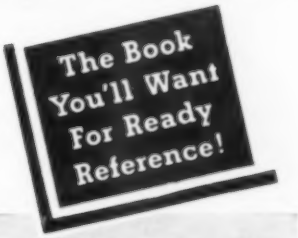
The two parts are joined together in much the same manner as many other quarter-turn cowl and panel fasteners.

When assembled the shank half of the screw is bayoneted down through the floating thread element and is given a quarter turn so that the small cross arm at the end of the shank slides up on two ledges against protrusions on the thread element end. Now the two parts of the screw act as one; torquing up the shank screws so the thread and assembly can proceed as if the fastener were a conventional screw.

Wedging Action

For anti-vibration locking action the thread element is slit so that it is free to pant.

As the element's threads bear up against the female threads inside the receptacle they ride up creating a wedging action which squeezes the



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TITEFLEX Flexible Metal Hose made from brass, monel, inconel, bronze, and stainless steel, conveys *all* types of organic and volatile liquids within an *extreme* temperature and pressure range for every type of aviation engine . . . including the most advanced jets and engines still on the drawing board.

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thread element firmly against the screw shank.

As a secondary safety-locking action a spring-loaded sleeve on the screw shank holds the cross arm securely in the notch on the thread element ledge until the fastener has been wrenched up into tension.

To increase the fastener's ability to take high driving torques Zahodiakin has incorporated the American Screw Co's. recently announced Torq-Set innovation on their Phillips-head cruciform shaped driving slot (AW July 9, p. 60). Thus the final tightening should be even greater than a comparable sized conventional permanent fastener.

As a companion product for the high strength fastener Zahodiakin has brought out what he feels is an improvement upon his quarter-turn "Paneloc" fastener (currently being manufactured under an exclusive license by the Scovill Manufacturing Co., Waterbury, Conn.) He calls the improvement "Spiron". Both new fasteners will be manufactured by Zahodiakin's firm, V. F. Zahodiakin Aircraft, Ltd., in Summit, N. J.

Air Industry Growth Shown By Census

United States' aircraft industry production in 1954 was valued at $3,449 million, an increase of 469% over 1947, preliminary data based on a detailed industrial census by the U. S. Department of Commerce reveals. Initial statistics were collated only recently and complete information is expected to be available soon from the Bureau of Census.

The Bureau gives the increase in terms of "value added," which is the value of work done by the industry less cost of materials, supplies, fuel, electric energy and contract work. The report covers all firms manufacturing or assembling complete aircraft, helicopters, gliders and lighter-than-air vehicles and companies doing modification, conversion and overhaul. Other segments of the industry, such as engine, propeller and equipment builders are not included in this report.

Census data on value of work done also includes that of secondary products, contracts and repair work and scrap sales; this totaled $52 million. The $6,315 million product value covered $5,495 million of complete aircraft, modifications and conversions and other services primary to aviation and $820 million in aircraft parts, engine parts, ordnance and accessories.

Figures were collected by the Bureau under legislation providing for a census of manufacturers every five years, with the next one due in 1958.

Supercharger Raises Helicopter Altitude

Los Angeles—Problems of climate and altitude that have limited helicopter operation are being minimized with a supercharger manufactured by McCulloch Motors Corp., and adapted to the Hiller 12-B and 12-C helicopters.

Applied to the 12-C using aircooled motors' engine model 6V4-200-C33, it provides increases in altitude performance by maintaining rated sea level horsepower (200) up to 7,800 ft. CAA tests proved hover ceiling performance increased 4,900 ft. to 8,000 ft. at maximum gross weight.

Service ceiling of the craft has been increased through supercharging to 13,000 ft. Altitudes of more than 16,000 ft. have been attained.

Rate of climb capabilities of the aircraft improved, with approximately 400 ft. per min. reported possible at 10,000 ft.

Hot weather helicopter operation improved, not only over hot weather nonsupercharged flight characteristics, but over unsupercharged performance at standard temperature.

Supercharger is belt-driven by a pulley mounted on the tail rotor drive, with a two-position pilot operated clutch.

Total of 75 hr. of flight testing by the supercharged helicopter resulted in no important service difficulties.

Germans Order Home Built Military Planes

Bonn, Germany—West German Defense Ministry ordered 671 military airplanes from German firms. The contracts, totaling $8.3 million, are mostly for airframes, the engines to be bought abroad. The exception will be the Lycoming GO 435 to be built by Bayerische Motorenwerke in Munich under license.

Focke-Wolfe AG, Bremen, working with Prof. Blume of Duesseldorf, will build 194 Italian Piagio P 149 trainers; Flugzeugunion Sued Gmbh., consisting of Messershmitt AG, and Heinkel AG., will build 360 French Fouga GM 170R Magister French jet trainers, and Flugzeugbau Nord GmbH., consisting of Weserflug AG., Hamberger Fahrzeug GmbH. and Siebel ATG GmbH., will build 117 French Sncan 2501 Noratlas transports. All will be built under foreign license.

An order for 469 German Do 27 reconnaissance planes was placed some months ago with Dornier. The first planes from this order will be delivered early in October.

New... Titeflex high-temperature HOSE CLAMP

Withstands all Stresses Common to high-temp Clamp Applications

This new cushioned Titeflex Hose Clamp is made from tempered stainless steel. It is lined with die-formed metal mesh that retains its shape, cushioning quality and grip despite excessive heat, pressure, and the action of acids, lubricants and synthetic fluids.

Here, at long last, is a ruggedly designed clamp with vibration resistance and positive electrical bonding qualities. It is *the* all-purpose clamp for *all* hose and tubing connections in jet engines and other high-temperature applications.

Here's the *one* clamp that can satisfy *every* application on a jet engine. Its ease of installation plus unlimited shelf life are additional operating advantages. This will permit you to standardize on one clamp—the Titeflex high-temperature clamp.

Titeflex

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Please send additional information on your new High-Temp Clamp.

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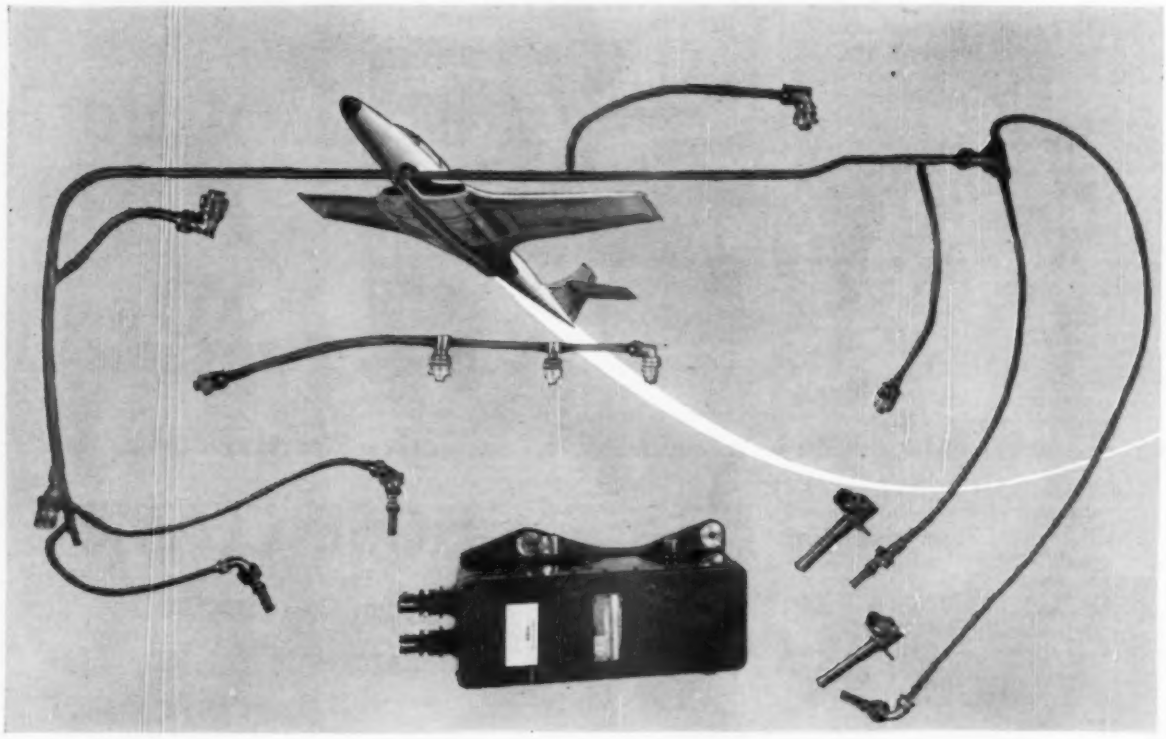

Offers a Complete Ignition System for JET ENGINES!

The most significant reason why the Scintilla Division of Bendix has long been recognized as the leader in aviation ignition is that Bendix-Scintilla designs, engineers and manufactures every component of the ignition system.

Obviously, components designed to work together give more efficient performance and require less attention in original installation or later service.

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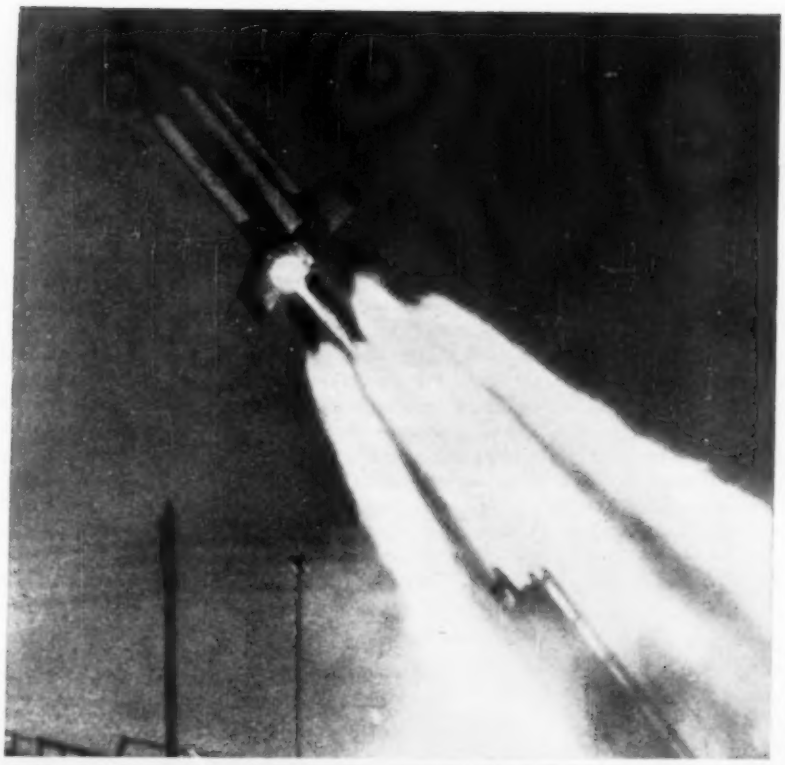
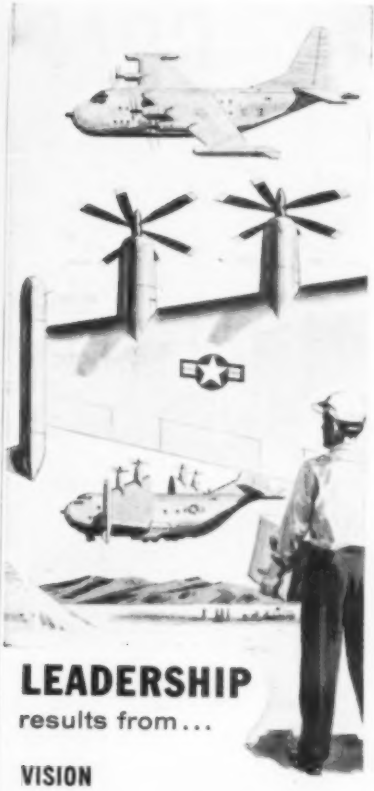


Rocket Test Vehicle

Bristol Aircraft Ltd. rocket test vehicle, one of several built to meet varying test requirements for rocket motor cases produced by Bristol, is launched from ground ramp. Booster rocket motors are accelerating the vehicle to supersonic speed, after which main sustainer motor takes over. Bristol is making motor cases for solid-propellant Raven, 120-mi. altitude range research vehicle, using high tensile sheet steel welded by Argon Arc process. Bristol is investigating other materials for cases, among them resin-impregnated glass fiber. Plastic materials are incorporated in design of some motor body types, and Durestos (phenolic resin-impregnated asbestos) is sometimes used in tailpipes.



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Working closely with the Army, Navy, and Air Force on many diversified projects, Hiller is pioneering future flight research, including the design of highspeed tilt-wing aircraft...retractable rotor convertiplanes...and advanced VTO, STOL designs.

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PRATT & WHITNEY J57 turbojet

• Boeing's B-52 Intercontinental Bomber, the striking arm of our Strategic Air Command, is powered by eight twin-spool axial-flow turbojet engines manufactured by the Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Connecticut. These turbojets are in the 10,000 pound thrust class and in engines of this caliber, complete dependability is vital. One of the components of the J57 is a GRAPHITAR air/oil seal employed on the turbine main shaft which, naturally, is turning at high speeds. The GRAPHITAR seal also easily withstands the maximum operating pressures developed in the engine. The slots in the face of the seal shown on the opposite page (approximately ⅔ size) are for pressure balance and cooling. This Main Shaft Seal is just one of several GRAPHITAR seals used in the J57 engine. GRAPHITAR parts can resist such taxing physical conditions because they are strong, self-lubricating, and practically inert. GRAPHITAR has excellent wearing properties and cannot be corroded by most chemicals. Where the application is rough, and complete dependability important, GRAPHITAR is the engineering material to specify.

THE UNITED STATES

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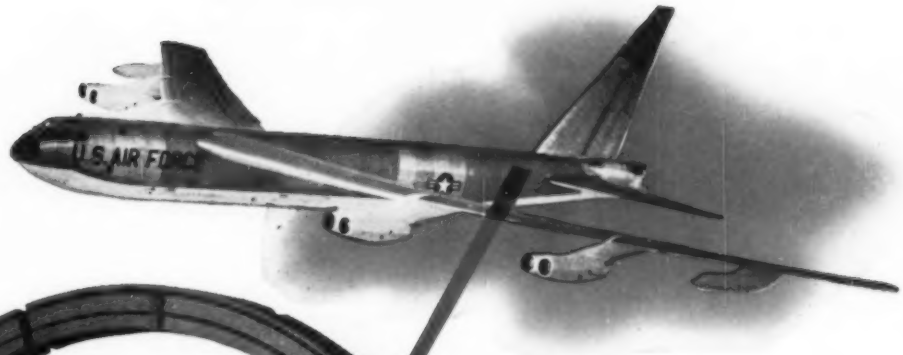
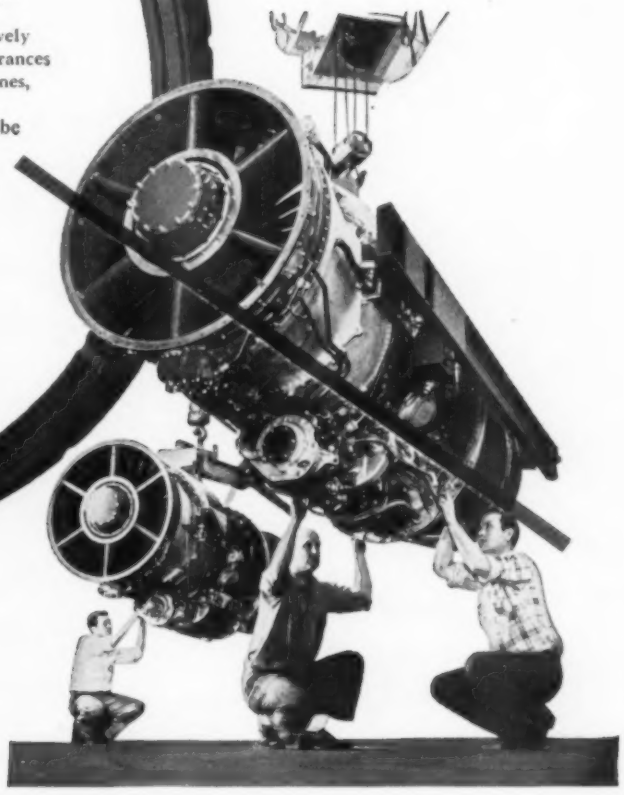


● From the B-52 to the atomic submarine Nautilus, from automobile pumps to automatic toasters, GRAPHITAR is aiding the performance of literally hundreds of highly diverse products. This versatile engineering material is compacted under extreme pressure and fused at heats near 4500°F. It can be formed in relatively complicated shapes and ground to tolerances as close as .0005" for seals, bearings, vanes, piston liners, and many other parts. GRAPHITAR is self-lubricating . . . can be used where only steam or water are present. It is lightweight, strong, durable, chemically inert, and is virtually unaffected by extremes of heat, pressure, or temperatures.



write for your copy of the new GRAPHITAR Engineering Bulletin No. 20

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

happy birthday, **"TRUCULENT TURTLE"!**

In September, 1946, the U.S. Navy, anxious to test its brand-new patrol bomber, took the 3rd P2V off the Lockheed production line, dubbed it "The Turtle," and headed for the Land Down Under...

...Blasting aloft from Perth, Australia, with JATO (and 8467 gallons of gasoline and a kangaroo mascot aboard), "The Turtle" flew non-stop without refueling to Columbus, Ohio—a distance of 11,236 miles, in 55 hours and 17 minutes! Newspaper reporters promptly renamed the record-breaking plane "The Truculent Turtle."

LOCKHEED

AIRCRAFT CORPORATION

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Look to Lockheed for Leadership

That historic Australia-to-Ohio flight is *still* the world's unrefueled non-stop record. On this, the 10th Anniversary of the memorable flight of "The Truculent Turtle," Lockheed salutes the gallant Navy pilots and crew members who wrote that brilliant and enduring page in aviation history.

Like all airplanes designed and built by Lockheed, the original *Neptune* was endowed with advanced design characteristics—thus permitting evolutionary improvements in subsequent P2V versions, at lowest cost to the U.S. Navy. A total of 24 Navy contracts for *Neptunes* is a tribute to their dependability, versatility and all-weather ruggedness—and to Lockheed's leadership in the design and production of long-range patrol aircraft.

Rocket Manufacturer To Expand Facilities

Horning-Cooper, Inc. of Monrovia, Calif., subcontractor to Grand Central Rocket Co. for the third stage rocket motor assembly of Martin's Vanguard satellite project, has changed its name to Cooper Development Corp.

Name change recognizes the company's concentration in the field of rocket and missile systems and electronic instrumentation development.

Cooper plans to build a two-story office building and additional manufacturing facilities to house a larger engineering, laboratory and testing operation and to increase the space available for production of the firm's ASP and WASP rocket systems. Cooper also designs or builds telemetering systems, wave guide rotary joints, microwave components and mercury-xenon illumination systems.

Name change is effective Sept. 15 and does not indicate a change of management.

Aeroquip Corp. Acquires Load Control Company

Aeroquip Corp., Jackson, Mich., has purchased General Logistics Corp., Pasadena, Calif., designer and manufacturer of aircraft load control and tie down equipment. Sales of General Logistics, which has 50 employes, are expected to reach the $1 million level within a year.

Two new products now being introduced are a special rope lock and a small mass-produced weblock buckle for strap assemblies.

WHAT'S NEW

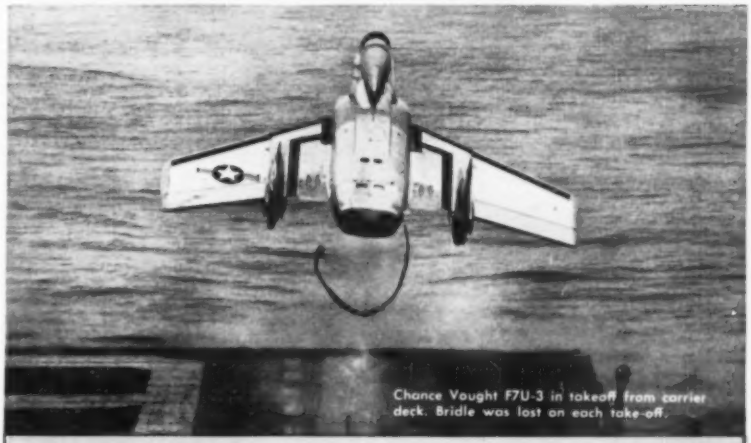
Publications Received

• *On-Line Automatic Data Reduction, Tunnel E-1, Gas Dynamics Facility, PB* 111810—by C. L. Hall and R. E. Klautsch, Arnold Engineering Center, U. S. Air Force—Available from OTS, U. S. Department of Commerce, Washington 25, D. C. $.75; 27 pp.

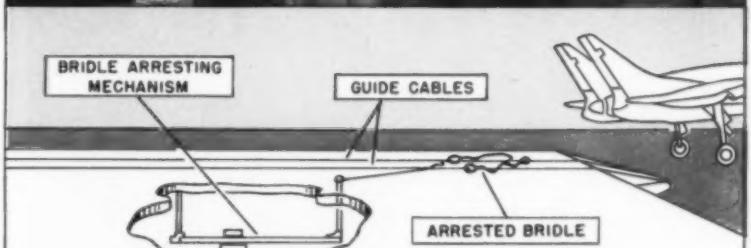
An automatic data reduction system capable of measuring, scanning, computing and presenting results of a wind tunnel test in one continuous operation is described.

• *The Emission Spectrographic Analyses of Titanium Metals and Alloys, PB* 121106—by E. M. DuBois and A. Tuteur, Spectrochemical Laboratories, Inc., and Lt. J. L. Mahan, Wright Air Development Center, U. S. Air Force—Available from OTS, U. S. Department of Commerce, Washington 25, D. C. $2.50; 100 pp.

NO MORE LOST BRIDLES...



Chance Vought F7U-3 in takeoff from carrier deck. Bridle was lost on each take-off.



AAE Bridle Arresting Gear in use. Note that the bridle lands safely on deck, immediately after disengagement from the catapulted plane.

THANKS TO ALL AMERICAN HIGH-CAPACITY BRIDLE ARRESTERS

In catapulting jets from the decks of aircraft carriers, each flight used to mean the loss over the side of the catapult bridle.

The U. S. Navy has now installed All American's Hi-Capacity Bridle Arresting Gear on all aircraft carriers equipped with steam catapults. Bridles are now saved for re-use.

This is another engineering project that spotlights All American's dynamic leadership in design, development and testing of new, vital equipment for the Armed Forces.

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WHO'S WHERE

(*Continued from page 23*)

F. E. Huggin, design specialist, Marvelco Electronics Division, National Aircraft Corp., Burbank, Calif.

James D. Esary, Jr., corporate manager-labor relations, Boeing Airplane Co., Seattle, Wash.

Willis J. Oldfield, public relations manager, AC Spark Plug Division, General Motors Corp., Flint, Mich.

Ellis F. Furda, district sales manager (Chicago, Ill.), Continental Air Lines.

Holley B. Dickinson, assistant to the president, Consolidated Electrodynamics Corp., Pasadena, Calif.

Robert E. Mitchell, sales manager, and **Leonard Larson,** chief engineer, Osborne Electric Co., Portland, Ore.

R. D. Eldridge, purchasing agent, and **Ivan L. Behrendt,** personnel manager, Telautograph Corp., Los Angeles, Calif.

Capt. Richard J. H. Conn (USN ret.), manager-Military Liaison Division, Service Dept., Wright Aeronautical Division, Curtiss-Wright Corp., Woodridge, N. J.

Almon W. Spinks has rejoined the staff of the Electrical Instruments Section of the National Bureau of Standards; he will be in charge of the Bureau's Aircraft Electrical Network Laboratory.

Joseph J. Putegnat and **Walter J. Howard** are now on the professional staff of Planning Research Corp., Los Angeles, Calif.

Haydn R. Jones, comptroller, Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J. He succeeds **W. G. Majeske** who is retiring.

Dr. Mark Gardner Foster, director of research, Crosley Government Products Division, Avco Manufacturing Corp., Cincinnati, Ohio.

Frederick G. Stroke, operations manager, Bettinger Corp., Waltham, Mass.

Eugene L. Olcott has joined the staff (Chemistry Division) of Atlantic Research Corp., Alexandria, Va.

E. L. Burkhart, personnel director, Vickers, Inc., Detroit, Mich.

Eli M. Goldfarb, senior project engineer, Levinthal Electronic Products, Inc., Redwood City, Calif.

John A. Maciag, assistant director-economic planning, Seaboard & Western Airlines.

Matthew H. Portz (Cmdr., reserve) has joined NACA Lewis Flight Propulsion Laboratory, Cleveland, Ohio as Aeronautical Information Specialist.

Donald G. McKee, central district sales manager (Dayton, Ohio), and **William Poellmitz,** northeast district sales manager, Aviation Products Division, Fenwal, Inc., Ashland, Mass.

Robert W. Hallam, district sales representative (San Francisco, Calif.), Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

Raymond R. Phillips, plant superintendent, Kellett Aircraft Corp.

Robert F. Feland, Jr., general sales manager, **A. G. Kelly,** department head-new products division, and **Robert D. Melcher,** personnel and industrial relations manager, Cal-Tronics Corp., Los Angeles, Calif.

Actual test firing of a modern ROCKETDYNE rocket engine at the Field Test Laboratory in the Santa Susana Mountains.

The mightiest engines ever built

will drive America's long-range missiles

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Already ROCKETDYNE engines are being supplied for the U.S. Air Force SM-64 NAVAHO long-range, surface-to-surface guided missile ...the REDSTONE surface-to-surface ballistics missile of the Army Ordnance Corps... and for many other large guided missile projects.

For the past 10 years ROCKETDYNE has been working closely with the Department of Defense, producing its rocket engines as required, and delivering them on time. New and more powerful rocket engine designs for tomorrow's more effective missiles are in constant development.

ENGINEERS: Investigate the career that awaits you in rocketry. Please write: ROCKETDYNE, Personnel Manager, Dept. W-32, 6633 Canoga Ave., Canoga Park, Calif. ...20 minutes from Los Angeles in suburban San Fernando Valley.

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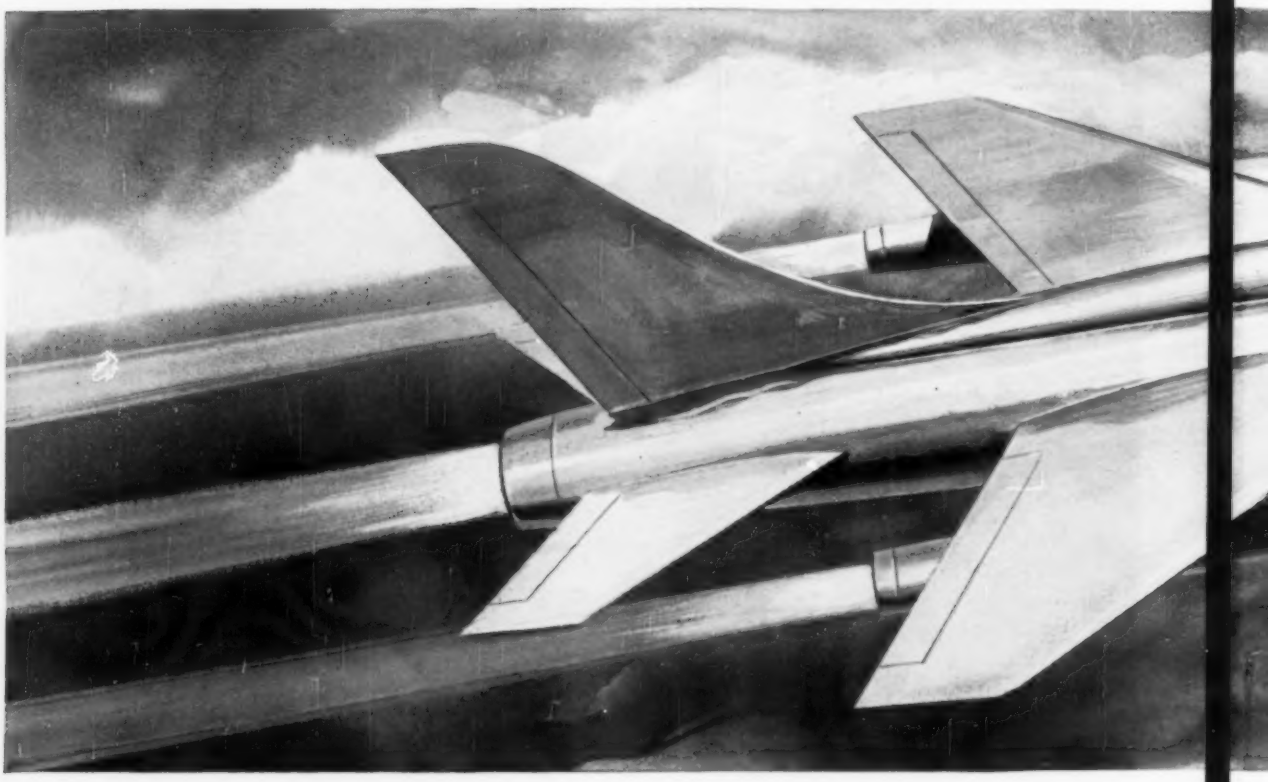
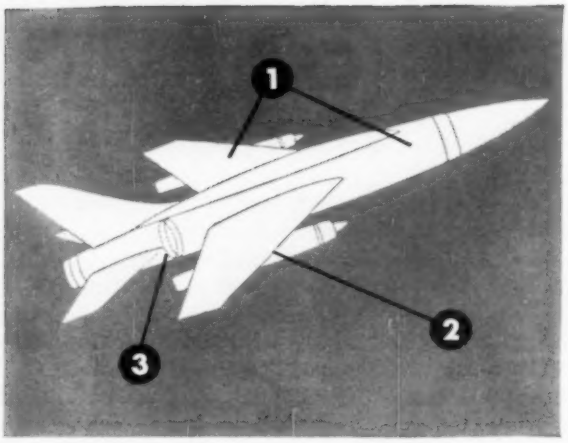
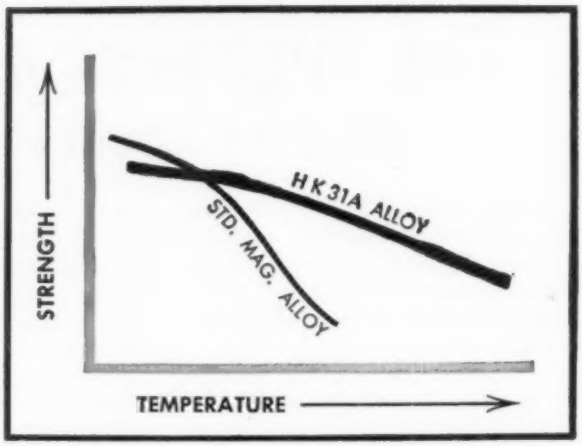
BUILDERS OF POWER FOR OUTER SPACE

NEW DOW MAGNESIUM ALLOYS



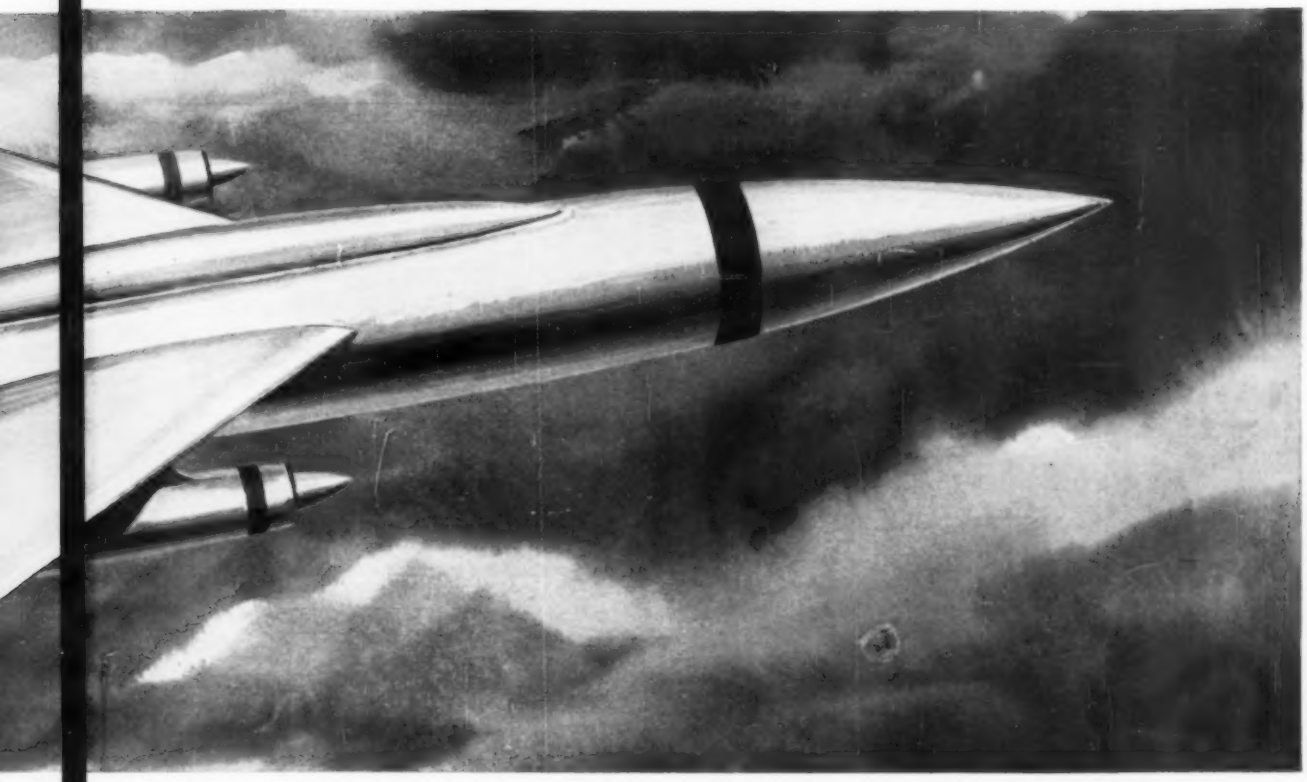


Now suggested *for a broad range of uses in missiles and aircraft, the new Dow magnesium alloys are available in the form of (1) sheet or plate, (2) extrusions, (3) castings.*



Maintenance of strength *at high temperatures is illustrated by this chart. Performance data on the new alloys at elevated temperatures can be obtained by request.*

CRACK HEAT BARRIER!



High temperature magnesium alloys are available to lighten aircraft and missile structures

Once again the horizons for aircraft structural design have been widened. Dow has developed a series of high temperature magnesium alloys which are already in pre-production use on aircraft, missile and engine structures. These alloys show advantages at temperatures up to 700° F. Limited test data on properties up to 800° F. are available for some of these alloys.

The new alloys save precious pounds because of their good combination of modulus and properties, including creep strength, at temperature. Shop characteristics include good formability and weldability.

One of the available alloys is the magnesium-thorium composition, HK31A, which is manufactured in rolled and cast form. Under development is a similar alloy for extruded shapes and forgings. HK31A sheet and plate are available from stock and from current mill delivery schedules in standard sizes from 0.016" to 2".

These new magnesium alloys by Dow should be considered for your high temperature requirements. Contact your nearest Dow sales office or write THE DOW CHEMICAL COMPANY, Magnesium Sales Dept., MA-361G-1, Midland, Michigan.

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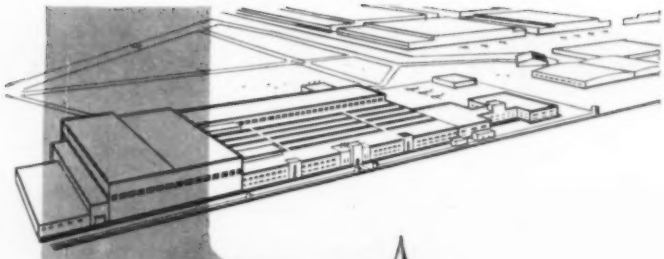
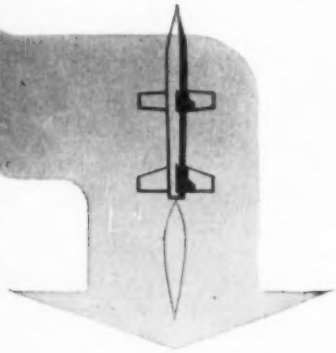
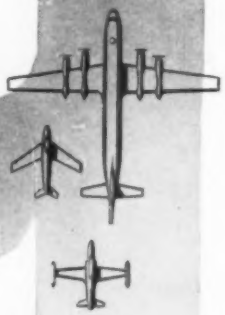
the CANADAIR contribution

Canada has received world-wide credit for the part she has played in the development of a strong NATO. Aside from material contributions to other nations she has made an equally important contribution to world peace by being strong herself . . . by keeping abreast of civilian as well as military progress throughout the world. Canadair is proud to be a part of Canada's strength in three important fields.







CANADAIR and GUIDED MISSILES

Canadair has long had a prominent role in Canada's guided missiles program. The company's experience in advanced aircraft systems engineering is applied to the design and development of these new supersonic weapons for the Canadian government.

CANADAIR and AIRCRAFT PRODUCTION

F86 Sabre jet fighters: Canadair produces this famous fighter for the RCAF and other NATO air forces. The fastest flying, highest climbing fighter aircraft in European multi-squadron service, the Sabre jet has proved its superiority in actual combat.

T33 Silver Star trainers: This Canadair-produced jet aircraft has become the standard trainer for RCAF and NATO student pilots.

Canadair CL28: This is the largest aircraft ever to be built in Canada, and will be used for reconnaissance duties by the Maritime Air Command of the RCAF.

CANADAIR and NUCLEAR PRODUCTS

In this new field of activity, Canadair's facilities for design, engineering, development and research are directed toward the production of test reactors for the government authority, Atomic Energy of Canada Limited. Canadair contributes to Canada's continuing program for the development of non-military uses for nuclear products.

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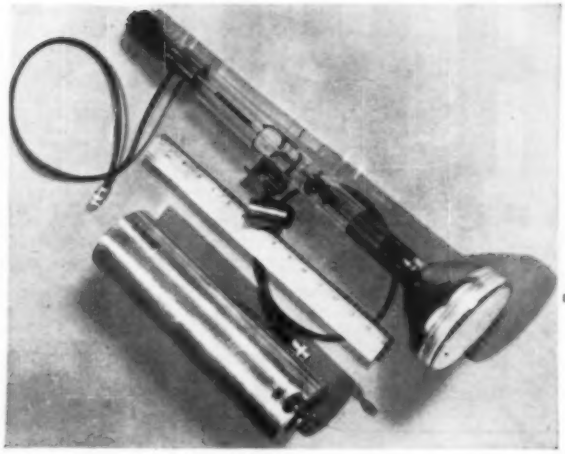
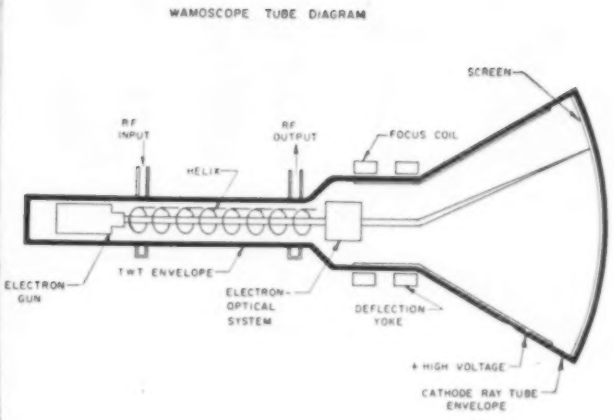




WAMOSCOPE, novel cathode ray tube which performs nearly all the functions of a complete radar receiver, has traveling wave tube amplifier built into its neck. Construction of new Sylvania tube is shown in schematic form in drawing (right).

Radar Receiver Built Into New CRT Tube

By Philip J. Klass

New York—Cathode ray tube which, by itself, performs nearly all the functions of a complete radar receiver has been revealed by Sylvania and the Office of Naval Research, which sponsored its development.

By eliminating the normal radar local oscillator, mixer, intermediate frequency amplifier, detector and video amplifier, the new device is expected to slash radar receiver size, weight, cost, and complexity. Greatly reduced complexity, Sylvania believes, should result in greatly increased radar reliability.

The device is called Wamoscope, short for Wave Modulated Oscilloscope. It consists of a traveling-wave tube amplifier built into the elongated neck of a cathode ray tube, with a special electron-optical system interposed between the neck and tube face.

Wamoscope's wideband (300 mc.) capabilities make it ideally suited for use with high-resolution radars which employ extremely short pulse lengths. The airport surface detection ("taxi") radar developed by Airborne Instruments Laboratory is a good example, a Sylvania spokesman says.

Now Available

Type 6762 Wamoscopes, for operation over the S-band frequency range of 2 to 4 kmc., are now in pilot production at Sylvania and available for immediate delivery to avionics firms working on military contracts.

The tube has a five-inch screen and uses P-7 phosphors. However, the company emphasizes that there is no practical limit on tube face diameter or the type phosphor used. Sylvania has built a Wamoscope with a 12-inch face.

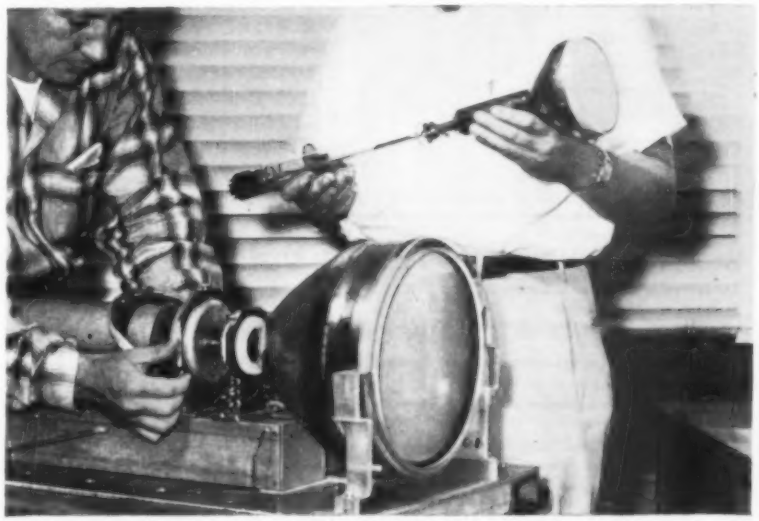
Available tubes have a maximum gain of 15 db. and a sensitivity of — 40 dbm. A spokesman says that the company is sure it can increase sensitivity to at least — 55 dbm., possibly higher. Because a typical radar requires a sensitivity of about — 80 dbm., it is necessary to use an external traveling-wave tube ahead of the Wamoscope as an RF amplifier, Sylvania points out.

Using one of the new low-noise S-band traveling-wave tubes now on the market in combination with a Wamoscope should produce a radar receiver with a 6 db. noise figure—comparable or better than most present conventional radar receivers, Sylvania says.

Velocity Sorting

Operation of the Wamoscope is based upon velocity sorting of electrons which emerge from the end of a helix of a traveling wave tube section. (See sketch, above.) An electron gun generates a d.c. beam which passes down the center of a helix to which the RF input is applied.

Interaction of the RF fields on the helix with the beam cause both velocity



NEW WAMOSCOPES can be built with any size screen, Sylvania says. Five-inch tube (top) is now in pilot production; 12-inch tube (bottom) is experimental model.

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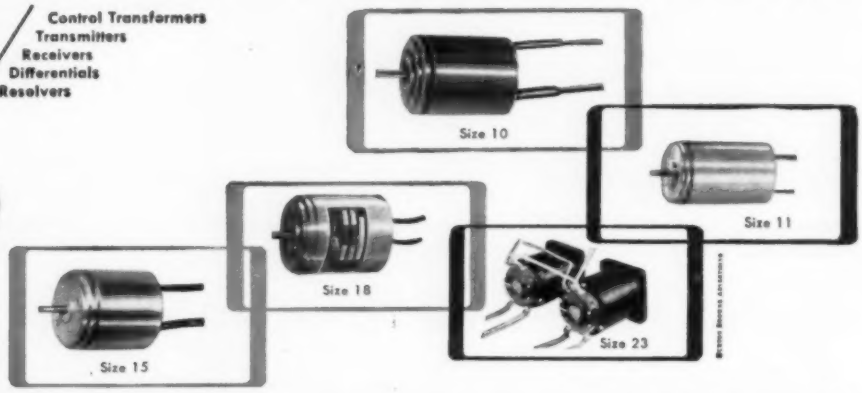

TYPE SYNCHRO	SIZE	OSTER TYPE	Frequency C.P.S.	Input Rotor Volts	Input Rotor Amps	Input Rotor Watts	Output Stator Volts	Input Stator Volts	Input Stator Amps	Input Stator Watts	Output Rotor Volts	Rotor Resistance Ohms	Stator Resistance Line to Line Ohms	Null Voltage	Angular Accuracy Maximum Spread
Control Transformer	10	3G-4055	400	26	0.030	0.30	11.8	11.8	0.060	0.20	21.3	160	45	0.050	30′
Control Transformer	10	3G-4079	400	26	0.008	0.10	11.8	11.8	0.018	0.10	20.3	510	200	0.050	30′
Transmitter	10	3G-4075	400	26	0.180	1.4	11.8	—	—	—	—	25	11	0.070	30′
Receiver	10	3G-4059	400	26	0.180	1.4	11.8	—	—	—	—	25	11	0.070	1½°
Differential	10	3G-4071	400	—	—	—	—	11.8	0.070	0.30	11.8	90	45	0.050	30′
Resolver	10	3G-4063	400	26	0.033	0.40	11.8	11.8	0.050	0.20	18.0	235	42	0.050	30′
Resolver	10	3G-4067	400	26	0.011	0.10	11.8	11.8	0.018	0.10	20.3	450	165	0.050	30′
Control Transformer	11	2C-4105	400	26	0.040	0.030	11.8	11.8	0.085	0.19	22.5	91.5	14.2	0.050	20′
Transmitter	11	2C-4125	400	26	0.150	0.80	11.8	—	—	—	—	20	4.3	0.050	20′
Transmitter	11	2C-4123	400	26	0.230	1.0	11.8	—	—	—	—	10.3	4.0	0.070	20′
Control Transformer	15	2G-4005	400	26	0.065	0.40	11.8	11.8	0.150	0.40	21.4	40	10.2	0.050	15′
Transmitter	15	2G-4025	400	26	0.225	1.25	11.8	—	—	—	—	9.5	3.8	0.070	20′
Receiver	15	2G-4009	400	26	0.10	0.45	11.8	—	—	—	—	16	6.7	0.070	45′
Differential	15	2G-4021	400	—	—	—	—	11.8	0.325	0.9	11.8	—	—	0.040	20′
Differential	15	2G-4041	400	—	—	—	—	11.8	0.120	1.3	11.8	14	10.2	0.050	15′
Resolver	15	2G-4017	400	26	0.014	—	18.0	18.0	0.015	—	21	239	180	0.050	40′
Transmitter 12 Power	18	3H-3309	400	26	0.77	2.3	11.8	—	—	—	—	1.032	0.675	0.050	20′
Differential	18	3H-3301	60	—	—	—	—	90	0.070	2.0	90	730	385	0.125	24′
Transmitter	23	3J-4222	60	115	0.120	3.2	17.0	—	—	—	—	140	8.3	0.050	30′

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and current modulation of the beam in accordance with the amplitude of the RF signal, Sylvania says.

The modulated beam then enters an electron-optical system whose aperture is controlled by a suitable bias voltage. Beam electrons whose velocity is greater than the d.c. velocity of the original beam are able to pass through the aperture and strike the CRT screen. Slower electrons are reflected and fail to pass through the aperture.

Conventional focus coils and deflection coils are used to focus and position the beam on the tube face.

Future Prospects

Sylvania says the Wamoscope can be designed for a wide range of frequencies and reports current developments up through K-band. Present tubes measure approximately 23¼ in. long, but Sylvania has one under test which measures only 21 in., and another on the drawing board with length cut to 17 in.

Wamoscopes are to sell for less than $500 if production quantities reach those of present radar CRTs. Sylvania sees the possibility of applying the Wamoscope to TV receivers. If this prospect materializes, the increased quantity production will further drop Wamoscope price. The Wamoscope has the same brightness as a regular TV tube, Sylvania says.

AIL Comments

AVIATION WEEK asked Airborne Instrument Laboratory engineers about the possible application of the Wamoscope to their "taxi" radar and for their reactions to the new Sylvania device. Bert Fowler, co-head of AIL's Radar-Navigation Dept., calls it a significant development.

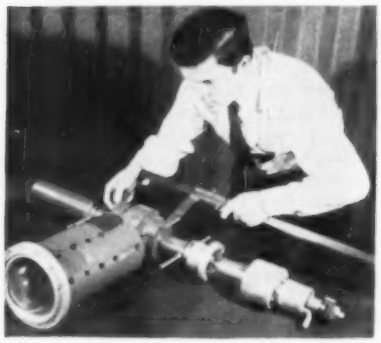
In the present AIL "taxi" radar design, the incoming 24,000 mc. signal is hetrodyned down to 130 mc., then remoted to the radar intermediate frequency (IF) amplifier and video amplifier in the tower scope console. If the new Sylvania Wamoscope were used, the radar signal would be hetrodyned down to 3,000 mc. (S-band), then remoted to the tower console. Here it would be amplified by two or three traveling wave tubes, then introduced into the Wamoscope.

Tubes Eliminated

This would eliminate approximately 70 tubes presently used in AIL's distributed type IF amplifier and video amplifier, according to Joseph Woodward, who heads the section under which the "taxi" radar was developed.

This significant saving in tubes and associated circuitry explains why Woodward and Fowler are optimistic over the Wamoscope's potentialities. However, Woodward points out a consequent disadvantage: failure of a single element in the Wamoscope requires costly replacement of the complete assembly compared to low-cost replacement of individual components possible in a conventional radar design.

Sylvania reports that it plans to use the Wamoscope in a new military equipment of undisclosed nature which



Magnetron

Magnetron, nicknamed "Big Maggie," delivers more than 10 megawatts power which enables powerful shipboard radar installed on cruiser U.S.S. Northampton to spot aircraft 400 mi. away, according to Westinghouse Electric which built the tube. Magnetron operates without pressurization, using water and mild forced air cooling.

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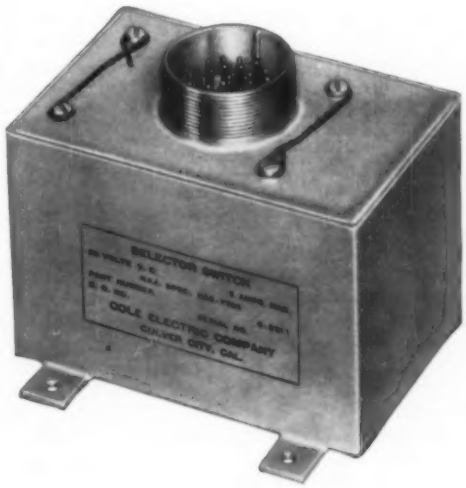

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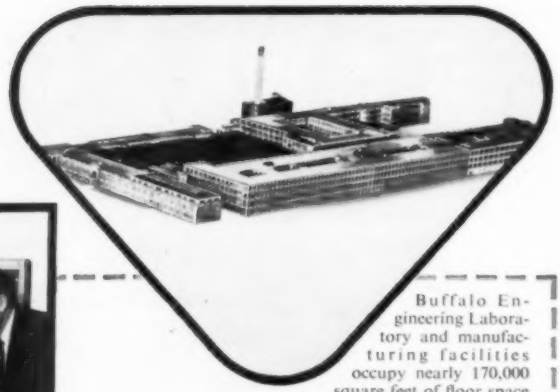
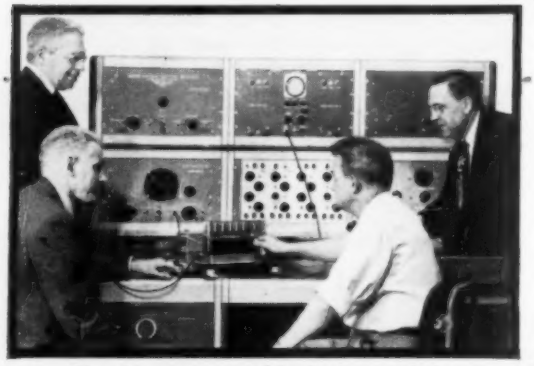


Buffalo Engineering Laboratory and manufacturing facilities occupy nearly 170,000 square feet of floor space in this industrial center at 175 Great Arrow Ave., Buffalo 7, New York.



Observing measurement of circuit parameters in the Electronic Systems Division's Buffalo Engineering Laboratory. From left: *H. C. Tittle*, Manager—Buffalo Operations; *M. C. Scott*, Manager—Buffalo Engineering Laboratory; *R. W. Ferry*, Assistant Product Engineering Manager and *A. W. Puttick*, Product Engineering Manager.

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Engineered in the Buffalo Engineering Laboratory of Sylvania's Electronic Systems Division, this highly advanced electronic system employs subminiature tubes, transistors, and printed circuits in a package which is itself subminiaturized. Despite its complexity of design and purpose, it is engineered for quantity production in the Division's Buffalo plant.

In all of Sylvania's Electronic Systems Division installations, the right people work with the right facilities, within a sound managerial environment. That is why they have produced the right solutions to a variety of problems, and have made such important contributions in the fields of aviation electronics, guided missiles, countermeasures, communications, radar, computers and control systems. Whether the problem is military or industrial, Sylvania's business is to come up with electronic solutions that are *producible*.

In addition to its Buffalo Engineering Laboratory and manufacturing facilities, the Electronic Systems Division has installations at Waltham, Mass., and Mountain View, Calif., staffed with top-ranking scientists and engineers, and backed by Sylvania's extensive resources in the electronics field.

SYLVANIA IS LOOKING FOR ENTERPRISING ENGINEERS

Sylvania has many opportunities in a wide range of defense projects. If you are not now engaged in defense work, you are invited to contact Edward W. Doty, Manager of Personnel, Electronic Systems Division, Sylvania Electric Products Inc., 100 First Avenue, Waltham 54, Mass.

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is under development by the company.

The Wamoscope was developed by Sylvania's Research Center, Bayside, N. Y. The name was suggested by three Naval Research Laboratory scientists, Neil L. Davis, Isaac W. Fuller, Jr., and Roger E. White, who were associated with the project.

FILTER CENTER

▶ **Sign Of The Times**—Douglas DC-8 jetliner will carry 1,200 lbs. of avionic equipment costing $140,000—more than the entire cost of a prewar DC-3, Douglas Engineer R. H. Jerome reported during the recent Western Electronics Convention (Wescon). Other interesting figures on DC-8 avionics included:

- **1,200 lb. of wire** and installation fixtures
- **4 to 5 mi. of wire.**
- **26 radio systems and 20 antennas.** Three of the antennas are external types and two are semi-flush. DC-8 will use an external VHF communications antenna whose actual drag, plus weight, is only 14 lb., compared to 45 lb. required for a flush antenna, Jerome reported. (On DC-8, one sq. ft. of parasitic drag area is equivalent to 1,200 lb. of actual weight.)

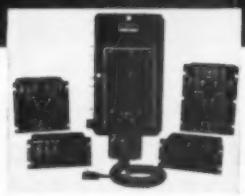
▶ **Collins ATC Transponder**—Collins Radio is building approximately 50 air traffic control transponder beacons for service test by selected airlines. Unit weighs about 23 lb.

▶ **New Missile Tubes**—Sylvania has announced a new line of seven subminiature tubes, designed under military contract, for guided missile applications. The new tubes, which are available for evaluation by companies engaged in missile work, include:

- **SN-1774A:** RF sharp cutoff pentode
- **SN-1775A:** Semi-remote RF pentode
- **SN-1776A:** Audio amplifier. (This tube recently has been released to interim specs as Type 6788)
- **SN-1777A:** Audio beam power pentode
- **SN-1778A:** Medium-Mu single triode with relatively high G_m for general purpose use up to 250 mc.
- **SN-1802A:** Medium-Mu double triode
- **SN-1803A:** High-Mu double triode.

▶ **Sperry Rand-IBM Agreement**—Sperry Rand Corp. and International Business Machines Corp. have entered into nonexclusive licensing agreement to exchange rights to manufacture punched card accounting machines and electronic data processing machines under patents and patent applications in ex-

with TI transistorized intercom



TI PRODUCTION ENGINEERING helped Lockheed trim 55 lb of dead load from the P2V-7 sub-hunting Neptune . . . by transistorizing just one system — the 14-station intercom. In addition to saving weight, safety and reliability were *increased* while maintenance and power drain were *reduced*.

Well within MIL-T-5400 for general performance, MIL-T-5422C for evironment, and MIL-T-6181B for interference, this TI-built system has a 2000-hr maintenance cycle and an exceptionally long service life. Signal response is instantaneous without need for warm-up. There is negligible power drain on standby and negligible heat dissipation while in use. The system takes power directly from a 28 Vdc line and uses less than 6 watts per station.

This is one example of Texas Instruments *systems engineering* now being applied to audio, radio, radar, sonar, infrared, and other systems for communications, navigation, search, fire control, and missile control. Continuing progress over a quarter century has resulted in over a third of a million sq ft of engineering and manufacturing facilities — soon to be doubled — located in an excellent dispersal area.

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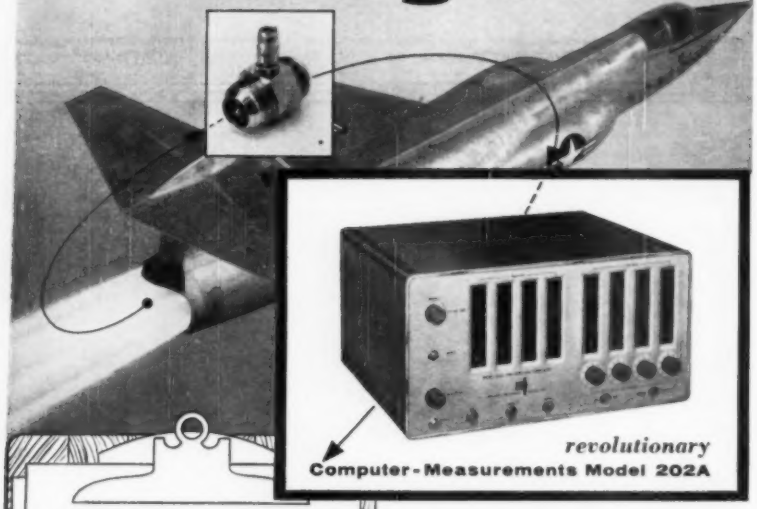

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SPECIFICATIONS:	
Frequency Range:	1-100,000 cycles per second 0-100,000 positive pulses per second
Input Sensitivity:	0.05 volt rms: 10-100,000 cps (5 millivolts optional) 0.07 volt rms: 1-10 cps Positive pulse rise time: ½ volt or more per sec.
Input Impedance:	0.5 megohm and 50 mmf.
Accuracy:	± 1 count ± stability
Stability:	Short Term: 1 part in 1,000,000 Long Term: 5 parts per million per week
Time Bases:	0.001 to 10 seconds in 1 millisecond steps 0.0001 to 1 second in 0.1 millisecond steps (0.0001 to 10 sec. in 0.1 millisec. steps, 0.001 to 100 sec. in 1 millisec. steps optional)
Read-Out:	Direct. Four digits. (Five digits optional)
Display Time:	Automatic: Continuously variable, 0.1 to 10 sec. Manual: Until reset
Power Requirements:	117 volts ± 10%, 50-60 cycles, 250 watts (50-400 cycles optional)
Dimensions:	17" W x 8¾" H x 13½" D
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istence as of Oct. 1, 1956. Based on IBM's greater production of these machines, the company will pay Sperry Rand a fixed annual royalty of $1,250,000 for eight years as a credit against production royalties, after which no further payments will be due. Two firms also agreed upon procedure for settling patent interferences now pending in U.S. Patent Office. Anti-trust violation and patent infringement actions brought earlier by the companies have been withdrawn.

▶ **"Talking Beacon"**—Air Associates has received first order for two of its "Talking Beacons" (AW Dec. 12, 1955, p. 53) from Army Signal Corps. The talking beacon automatically gives liaison aircraft, equipped only with VHF communications receivers, their bearing to station by tape-recorded voice.

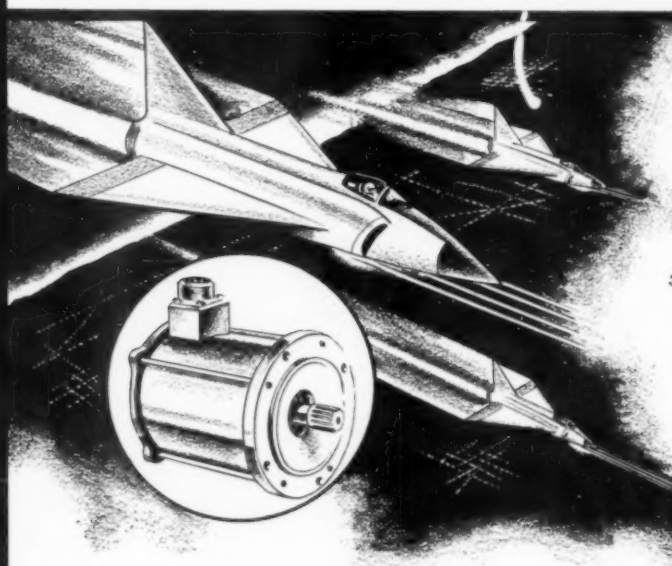
▶ **New AEW Radar**—Navy has ordered new higher-power airborne early warning search radars, employing "new design principles," from General Electric's Light Military Electronic Equipment Dept. (LMEED). Contract, for pilot production, amounts to approximately $1 million, GE says.

▶ **Automatic Telemetry Tester**—Development of an automatic "Go, No-Go" type test set which can give a pre-flight checkout to a 20-channel FM/FM missile telemetering system in less than two minutes, was reported at the recent Wescon in Los Angeles. (Howard A. McGee, United Electrodynamics Corp. and P. S. Klasky, Northrop Aircraft, co-authored the paper.) The device checks carrier frequency and power to pre-set tolerances, then checks the frequency and amplitude of each subcarrier channel. If pre-launching value of each subcarrier is not well-defined, calibrating signals are fed into the subcarrier oscillators. When tester finds a fault, it identifies the channel and reason for rejection.

▶ **New Backward Wave Oscillators**—Bell Telephone Laboratories has developed backward wave oscillators operating in the 3.5 to 7.2 millimeter (wavelength) region, capable of delivering 2 to 20 milliwatts, C. F. Hempstead reported at Wescon.

▶ **Volscan Goes West**—Following preliminary tests by AF Cambridge Research Center on the new Crosley-built Volscan system, it is being moved to Clinton County Air Force Base (Ohio) for extensive operational evaluation. After two months of testing at Ft. Dawes, near Boston, Crosley says that Volscan has demonstrated its ability to "triple the capacity of many airports throughout the country."

AVIATION PROGRESS with G-E aircraft motors

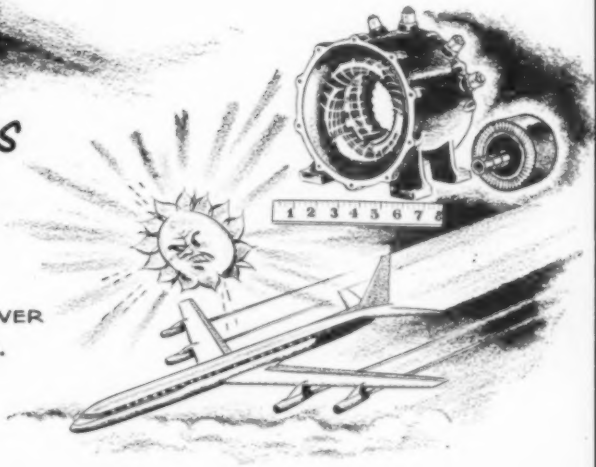


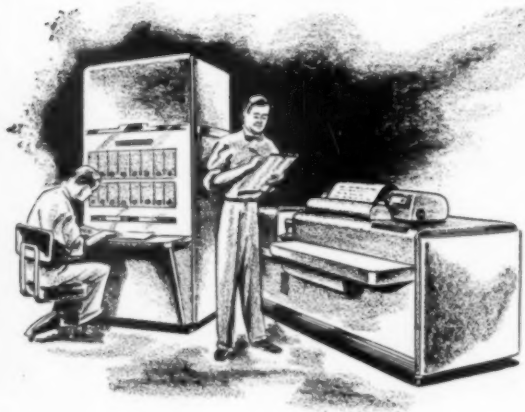
NEW G-E AIRCRAFT GUN MOTOR DEVELOPS **TWO HP PER POUND** FOR 10 SECONDS!

POWER PLUS HAS BEEN PACKED INTO THIS COMPACT 18 POUND, 400 CYCLE MOTOR WHICH DELIVERS 37 HP FOR A 10 SECOND FIRING INTERVAL. NEWLY DEVELOPED INSULATION SYSTEM PROTECTS AGAINST INTENSE HEAT. DOUBLE ROTOR DESIGN PROVIDES HIGH STARTING TORQUE AND EXCELLENT OPERATING EFFICIENCY- PERMITS UTILIZATION OF SINGLE OR DUAL POWER SOURCE.

G-E HERMETIC MOTOR PARTS LESS THAN 6½ INCHES IN DIAMETER DELIVER **25 HP CONTINUOUSLY** TO COOL AIRLINERS!

HERMETIC MOTOR PARTS WEIGHING ONLY 18 POUNDS DELIVER 25 HP CONTINUOUSLY AT A SPEED OF 23,500 RPM. TWO-POLE, 400-CYCLE POWER PACK CONSISTING OF STATOR, ROTOR AND SHELL IS DESIGNED TO POWER AIRBORNE COMPRESSOR.





DIGITAL COMPUTER DETERMINES BEST MOTOR DESIGN IN SECONDS!

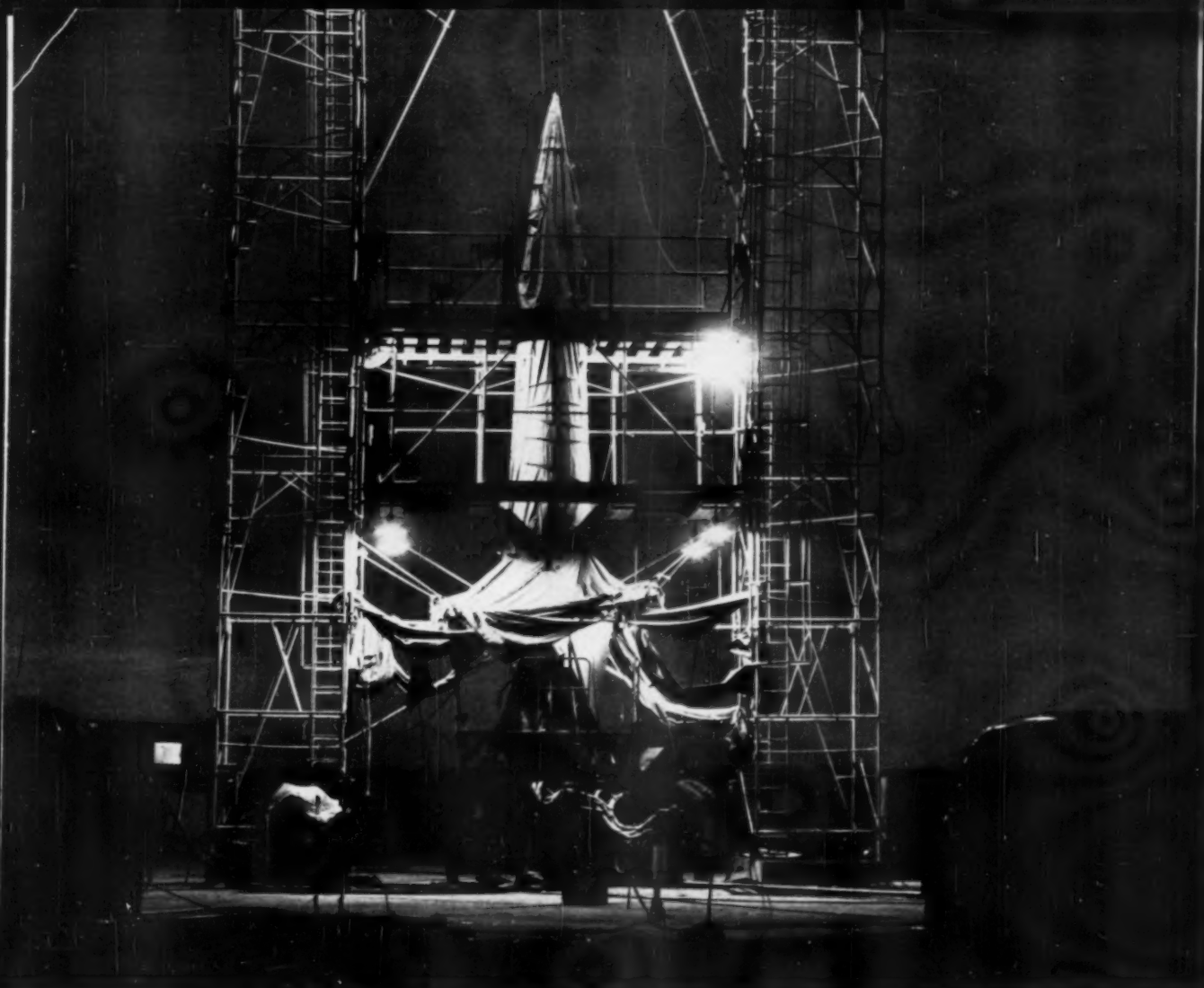
DAYS OF CALCULATIONS BECOME SECONDS WHEN G-E AIRCRAFT MOTOR DESIGNERS PUT THIS COMPUTER TO WORK IN DETERMINING OPTIMUM MOTOR DESIGN IN THE FASTEST POSSIBLE TIME! AFTER PRELIMINARY DESIGN WORK HAS BEEN COMPLETED, COMPUTER CAN THEN BE INVALUABLE AID IN ASSURING BEST - AND FASTEST - POSSIBLE ANSWER TO YOUR MOTOR REQUIREMENTS.

THESE ARE ONLY A FEW EXAMPLES OF G.E.'S CONTINUING DESIGN LEADERSHIP. FOR HELP ON YOUR AIRCRAFT MOTOR PROBLEMS, CONTACT YOUR NEARBY G-E APPARATUS SALES OFFICE

GENERAL ELECTRIC CO., SECT. 634-5
SCHENECTADY, N.Y.

Progress Is Our Most Important Product

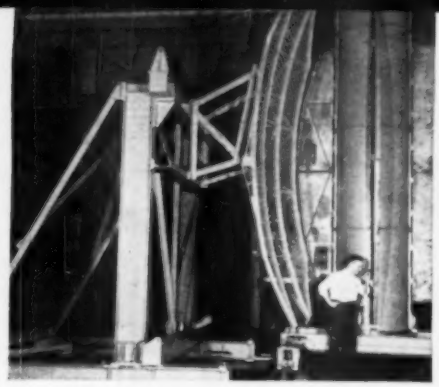
GENERAL ELECTRIC



ZERO minus 4 hours! A G-E test missile, still shrouded in the early morning dampness before launching, represents more than a decade of research and development.

THESE G-E CAPABILITIES ARE AVAILABLE TO

BASIC RESEARCH



COMMUNICATIONS

HYPERSONICS

At General Electric, George F. Metcalf reports:

New Department to Help Solve Complex Defense System Problems

GEORGE F. METCALF, is General Manager of General Electric's new Special Defense Projects Department, located in Philadelphia, Pa. Mr. Metcalf has had extensive management experience in the military electronics field, both in Government Service and in the General Electric Company's Electronic Division.

Realizing the increased complexity of some of the nation's current defense system problems, General Electric has formed the Special Defense Projects Department. The new department will act as a Company focal point for large, highly complex missile projects. Headquarters for the new department will be located near Philadelphia, Pa. This new department has responsibility for large defense systems that require the combined research, development, and manufacturing resources of many of General Electric's operating departments and laboratories.

Manned by a highly skilled engineering and development staff, the Special Defense Projects Department relies upon General Electric operating departments and laboratories for many specialized phases of its defense projects.

The Special Defense Projects Department is making significant contributions to America's defense program by focusing the wide range of specialized talents of General Electric on highly complex defense system problems. Section 224-4, General Electric Co., Schenectady 5, N.Y.

ENGINEERS: G.E.'s Special Defense Projects Department is currently expanding its staff of highly skilled engineers and scientists. If you have a background of successful, creative engineering send your qualifications to: Mr. George Metcalf, 3198 Chestnut St., Special Defense Projects Department, General Electric Company, Philadelphia, Pa.

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NEW SPECIAL DEFENSE PROJECTS DEPARTMENT

METALLURGY

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and then we built

This 7 pitch, 19.1564″ pitch diameter internal gear for the Sikorsky S-58 Main Transmission

This HARD (Rockwell "50C") gear is cut after heat treating to master gear standards:

.0002″ per inch maximum lead error
+.0000 −.0003 involute error
.0002″ tooth spacing tolerance
60 RMS finish

INDIANA GEAR

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NEW AVIONIC PRODUCTS

Components & Devices

• **Subminiature ceramic capacitors,** Series 2000K, maintain 90% of rated capacitance over temperature range of −55C to 125C. Capacitor is rated 200

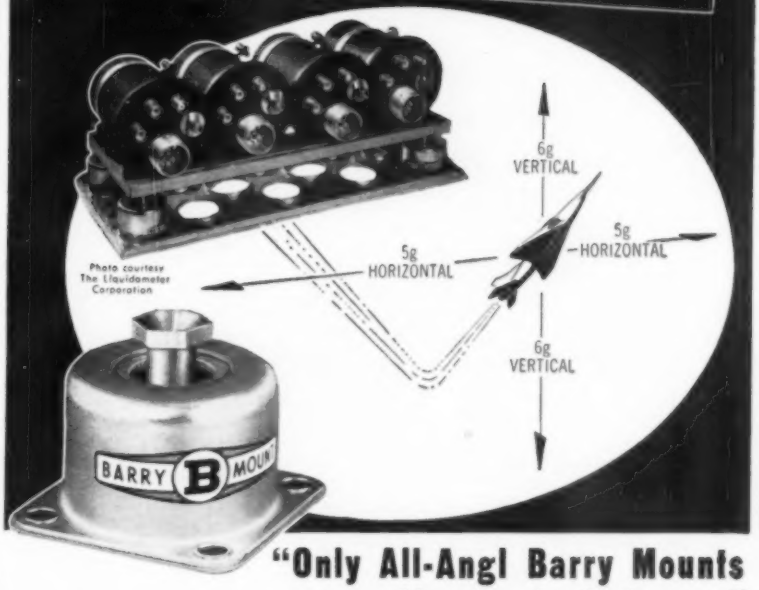
working volts d.c. Available in five sizes ranging from 0.0033 to 0.05 mfd. Valco Engineering Sales Co., 2538 So. Highland Ave., Los Angeles 16, Calif.

• **Miniature clutch/brake,** employs dry powdered iron. Model No. 10 clutch provides proportional control, is rated 80 in./oz. at 5,000 rpm. and has output inertia of 1.85 gr. cm². Speed of re-

sponse is 2 milliseconds. Fixed excitation coil eliminates slip rings and external bearings. Model 10 brake has similar torque rating. Electomic Mechanisms, Inc., Greenwich, Conn.

• **X-band rotary joint,** Model H250T/S61, broad-band waveguide coupler can handle 600 kw. peak power for short periods, 350 kw. for extended periods. Unit uses preloaded ball bearings to prevent change of characteristics during rotation. VSWR is less than 1.10 over frequency band of 8.4 to 9.6 kmc. Litton Industries, Components Div.,

PROVED...
protection under high-g
SUSTAINED ACCELERATION
of the new F-10 CLASSIFIED*



"Only All-Angl Barry Mounts gave effective isolation..."

*One of the newest and hottest fighter aircraft now flying gives its electronic equipment such a terrific slam, when afterburners are turned on or off, that sustained accelerations bottom out MIL-spec mounts — making vibration protection *nil*.

But in this same aircraft, All-Angl Barry Mounts protect the power units of Liquidometer's four fuel-gaging systems, maintaining vibration isolation under sustained accelerations up to 6g vertical and 5g horizontal.

The pilot's life — and the success of his mission — literally depend on the trueness of his fuel-gage readings! And these readings depend on the *protected reliability* of the vacuum tubes and circuitry in the power units.

- **In any mounting position**
- **Through every attitude of aircraft or missile**
- **Under sustained high-g acceleration . . .**

. . . All-Angl Barry Mounts give assured protection of reliability. Write for Data Sheet 956-01 giving details. For specific recommendations, call your Barry Sales Representative.

Barry's new Western Division, in Burbank, California, offers fast, on-the-spot design and prototype service, and production of special systems.

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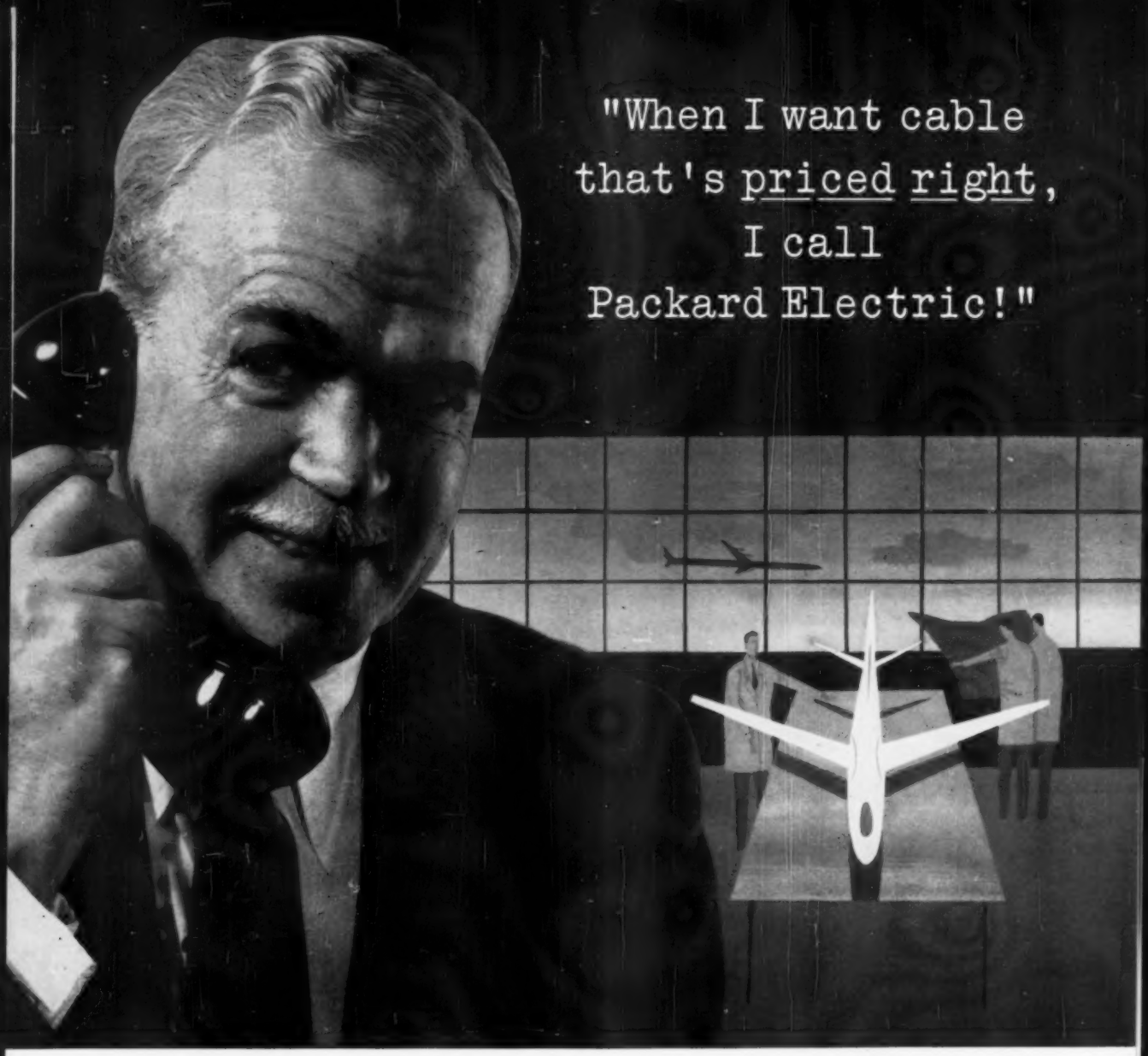
BARRY B MOUNT
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

715 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS



Huge production gives important advantages to bulk cable customers of Packard Electric

You don't have to sacrifice a thing or compromise rigid aviation safety standards to get cable at a price that is right.

From pre-World-War-I times, through the tremendously accelerated defense production schedules to the present, Packard Electric has always made uniform high-quality aviation cable available to airframe and engine manufacturers. Many times our engineers have worked closely with leading aviation firms to develop new cable to meet the ever-rising standards of the industry.

The resultant know-how has given us the ability to insure uniform high-quality cable production at relatively low cost. Our huge production capacity tops 7,000,000 feet of cable a day and is the biggest in the aircraft cable manufacturing industry. This volume makes possible additional advantages to bulk-cable customers without a reduction in quality standards.

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Packard Electric Division
General Motors, Warren, Ohio

Offices in Detroit, Chicago, and Oakland, California • Aviation, Automotive and Appliance Wiring

5873 Rodeo Road, Los Angeles 16, Calif., or 215 S. Fulton Ave., Mt. Vernon, N. Y.

• **Miniature transistor-magnetic** power supply, operates from 28 v.d.c. input, provides 115 v., 400 cps. and 150 v.d.c. output with a 25-watt load rating. De-

vice measures only 2x2½x3 in., weighs 1½ lb. Efficiency is approximately 90%. Hycon Manufacturing Co., 2961 E. Colorado St., Pasadena, Calif.

• **Teflon jacketed cables,** which also employ Teflon for dielectric, are now available in five types with impedances of 50, 70, 75, 93 and 130 ohms. Federal Telephone & Radio Co., Components Division, 100 Kingsland Road, Clifton, N. J.

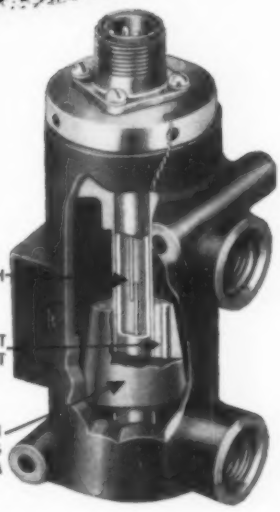
• **Digital counter** for use with multiturn potentiometers has knurled knob for precise adjustment of pot, with three dials capable of detent positioning in ½-digit increments to provide readout to one part in 2,000. Device also

can be used with precision capacitors or inductors. For more information on "Digimax" dial, write Maxson Instruments Div., The W. L. Maxson Corp., 47-37 Austell Place, Long Island City 1, N. Y.

Instrumentation

• **Miniature pressure transducer,** Type SLM, measuring ¼ in. dia. x ½ in. long, is available in four models: "blast", "shock tube", "ballistics" and "hyperballistics", covering range of pressures

Know when flow is low...
WITH
REVERE
FLOW
SWITCHES



Know whether fuel flow is safely above required minimum with this Revere flow switch. Only moving part is the float...non-absorbent for long-time accuracy. Permanent magnets in float actuate hermetically sealed Glaswitch* at preset minimum rate. Compact...low pressure drop. For a range of flow rates and pressures.

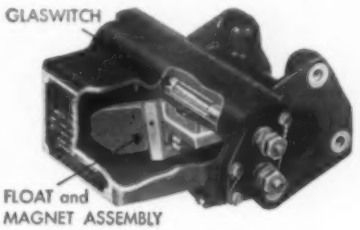
SPECIFICATIONS — F-8290 Flow Switch (typical)
Flow: 1.5 GPM
Weight: 0.70 lb.
Operating Pressure: 70 PSIG
Temperature Range: —65°F to 200°F

Know when a fuel line runs dry ...this Revere flow switch flashes a pilot light. Uses a venturi to create differential head during fuel flow to fill float cavity; this causes float and magnet assembly to actuate hermetically sealed Glaswitch*. Air replacing fuel in line drains switch cavity reversing switch action. Small size ... low pressure drop.

* Trademark

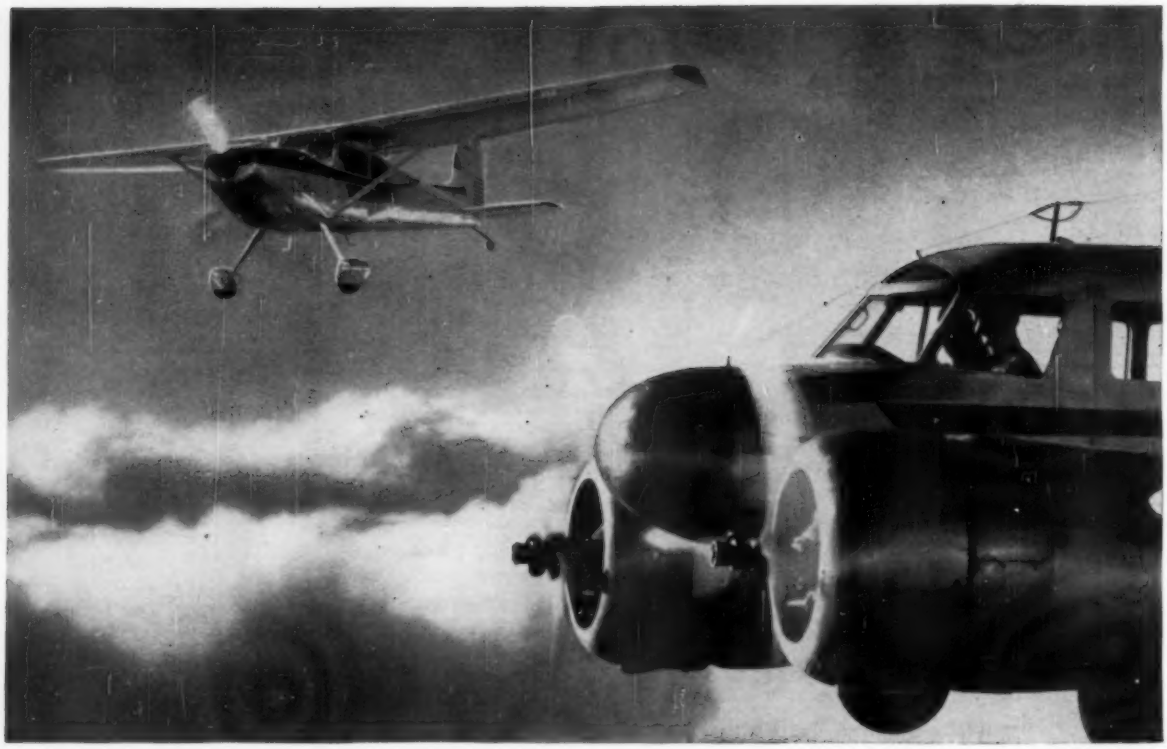
Ask for Engineering Bulletins 1055 and 1059 describing these Revere Flow Switches. Other types available.

SPECIFICATIONS — F-21110 Flow Switch (typical)
Flow: 3000 PPH minimum
Weight: 1.25 lb.
Operating Pressure: 35 PSIG
Temperature Range: —65°F to 165°F



Designed for aviation fuels. Conform to MIL-F-5572, MIL-F-5616 and MIL-F-5624A as well as applicable requirements of MIL-E-5272 and MIL-F-8615.

Revere CORPORATION OF AMERICA 18
WALLINGFORD, CONNECTICUT A Subsidiary of Neptune Meter Company



The Cessna 180 and Twin Cessna T-50

An important development for **all** types of aircraft engines!

NEW GULFPRIDE AVIATION SERIES D

GULF
AVIATION PRODUCTS

Here's a new oil that keeps *all* types of aircraft engines (horizontally opposed, inline or radial) cleaner than was ever possible before with non-detergent oils . . . and *without* developing any undesirable side effects.

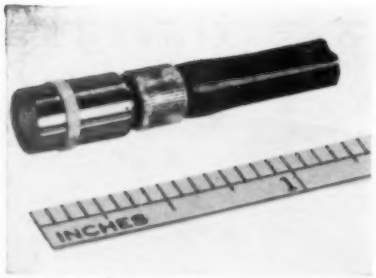
The secret? New Gulfpride Aviation Series D combines Gulf's exclusive Alchlor Refining with a remarkable new "detergent additive."

Cleaner Engines

Experience in all kinds of service proves New Series D greatly *reduces carbon, coke and varnish collection* around rings and valve stems. *Eliminates harmful deposits* in the combustion chambers.

More hours between overhauls

New Series D offers you an unusually tough lubrication film, too. *Cuts down wear on engine parts substantially.* The result? Far lower *operating* and *maintenance* costs! Safer *engine performance!* Why not try it and see for yourself?



from 0.01 to 100,000 psi. Kistler Instrument Co., 15 Webster St., North Tonawanda, N. Y.

• **Low-level d.c. amplifier,** Type MMO-422, employs transistor oscillator which enables it to operate directly from d.c. power source resulting in extreme gain stability. Device provides ripple-free 5 v.d.c. output from 1 mv. d.c. input. Amplifier employs magnetic amplifiers, comes in hermetically sealed plug-in case. Magnetic Research Corp., 200-202 Center St., El Segundo, Calif.

• **Direct-writing oscillograph,** two-channel, has flat frequency response to 250 cps., consists of Type 5-301 Datagraph (recorder) and Type 1-133 amplifier. Recorder employs electro-sensitive chart paper and a recording stylus that travels in rectilinear fashion. Any one of six

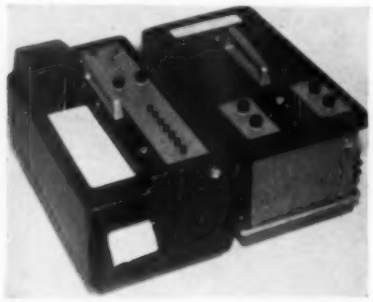


chart speeds, 0.05 to 20 in./sec., can be selected by pushbutton. Timing pulses are provided automatically at rate of one per second, or up to five pulses per second from external source. Recorder and amplifier operate from 115 v., 60 cps. Bulletin No. 1569 gives application data. Consolidated Electrodynamics Corp., 300 No. Sierra Madre Villa, Pasadena, Calif.

Microwave Devices

• **Midget TR tube,** Type 6795, which is 50% smaller than predecessor, has been announced by Sylvania. Tube operates over 8.5 to 9.6 kmc. band, meets or exceeds electrical characteristics of its older counterpart, the 1B63A TR tube. Sylvania also has announced a Type M561 tunable magnetron, with a 600 mc. tuning range over the 8.5 to 9.6 kmc. band. Tube has minimum power

UNEQUALED PERFORMANCE IN

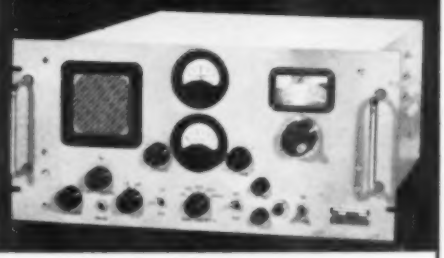
- **TELEMETERING**
- **GUIDED-MISSILE MONITORING**
- **RADIOSONDE RECEPTION**

This Special Purpose Receiver is an improved version of the NEMS-CLARKE 167-J1 and 167-J2. This new Receiver incorporates the best qualities of both of the former types plus many new features including a BFO. A video bandwidth control is provided to greatly improve signal-to-noise ratio when full bandwidth is not needed. It is especially useful as a high quality general purpose laboratory receiver.

NEMS-CLARKE
INCORPORATED
919 JESUP-BLAIR DRIVE
SILVER SPRING, MARYLAND

For further information write Dept. H-6

TYPE 1501 SPECIAL PURPOSE RECEIVER

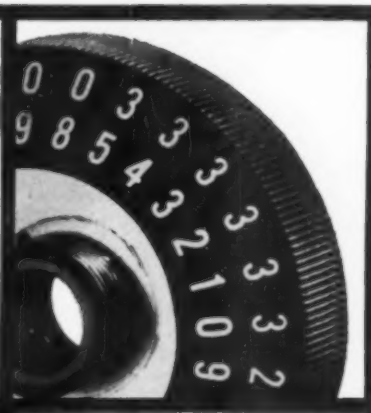


SPECIFICATIONS

Type of reception	AM, FM, or CW
Tuning range	55-260 mc
IF bandwidth	300 kc
Sensitivity (measured without band-restricting filters)	8 uv produces at least 23 db S/N ratio with 100-kc deviation, 400-cycle modulation.
Noise figure	11 db, maximum
IF rejection	Not less than 70 db
Image rejection	Not less than 40 db below 130 mc; 30 db minimum at any frequency.
FM output	0.15 volt per kc deviation (Approx.)
AM output	12 volts for 10 uv input modulated 30% at 1000 c.p.s. (Approx.)
Squelch	Operates on monitor circuit

have you Edge Lighting Problems?

The unparalleled design flexibility of the Lackon® photo-marking process may offer you the best solution. With a minimum of gimmicks and gadgetry, Lackon® gives you a panel of unequalled marking accuracy, optimum legibility and lighting uniformity, with excellent resistance to severe environmental conditions. Designed, tested and quality controlled in our government approved laboratory, Lackon® edge lighted panels, knobs and knob skirts meet and exceed lighting, legibility and durability requirements of specification MIL-P-7788.



The Lackon® engineering staff of the United States Radium Corporation will readily assist your panel engineering department during the initial design stage. The cooperative application of their skill and experience in lighting techniques will speedily resolve design difficulties, result in decided production economies, and yield a remarkably superior finished product. For information write Dept. AW-9

United States Radium Corporation
Hanover Ave., Morristown, N. J.

Regional Offices: 5420 Vineland Ave., N. Hollywood, Calif.; 4624 W. Washington Blvd., Chicago, Ill. Affiliates: In Canada — Radelin-Kirk Ltd., 1168 Bay St., Toronto, Ont.; In Europe — United States Radium Corp.—Europe, 36 Avenue Krieg, Geneva, Switzerland.

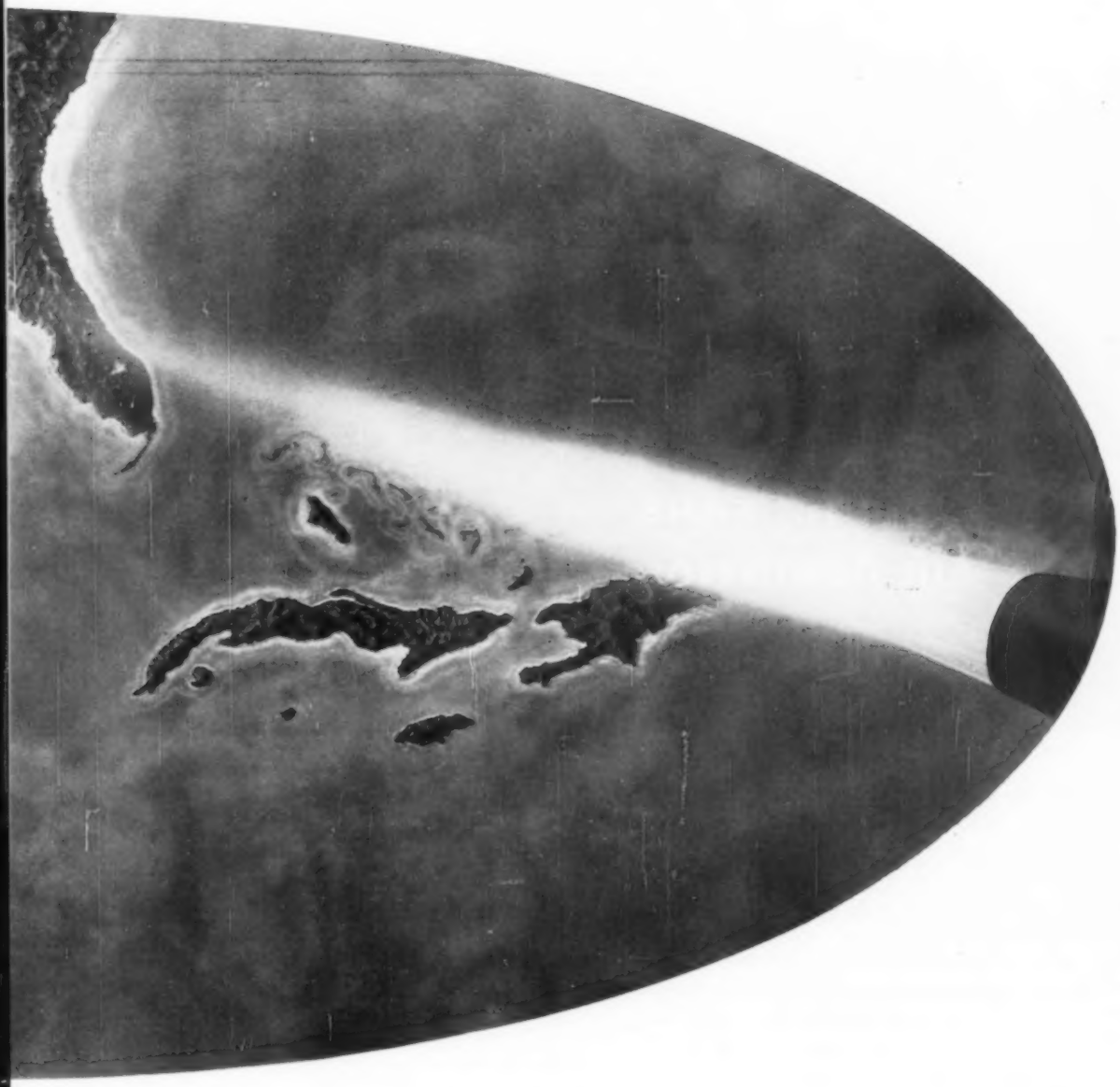
NORTH AMERICAN HAS BUILT MORE AIRPLANES

ABOVE THE OCEANS

The FJ-4 — newest, fastest-climbing, most maneuverable and longest-ranged FURY of them all — has completed its carrier suitability and fleet indoctrination tests. This latest addition to the Navy's operational squadrons is a product of North American's Columbus Division. Here, faster more effective manned aircraft are in continuous development — as they are in North American's Los Angeles plants, birthplace of the F-100 SUPER SABRE and the F-86 SABRE JET. This ability to deliver tomorrow's aircraft — in quantity, on time, and at lowest possible cost — has made North American Aviation a major supplier of advanced aircraft for our country's defense.

NORTH

THAN ANY OTHER COMPANY IN THE WORLD



ABOVE THE CONTINENTS

Even before the close of World War II, North American was at work in the vast technological world of guided missiles. One of today's major results of this pioneering is the SM-64 NAVAHO INTERCONTINENTAL MISSILE. North American has developed guidance systems, automatic navigation and flight control systems . . . as well as airframe and rocket power . . . for this important Air Force project. North American's work on the NAVAHO and other weapons systems is now creating long-range missiles to fill a high-priority need in our nation's defense.

North American Aviation, Inc., Los Angeles, Downey, Canoga Park, Fresno, Calif.; Columbus, O.; Neosho, Mo.

AMERICAN AVIATION, INC.

Engineers: write for details regarding challenging positions now open.

new airliner makes most of THIS space-saving design

CAPITAL AIRLINES is proud of its spanking new turbo-prop Viscounts. The finest aeronautical and electronic know-how has been employed in the development of this inspiring new airliner.

This advanced thinking is apparent, too, in the Viscount's air conditioning system. For the heart of the system they selected a Joy AXIVANE Fan . . . and used to full advantage the inherent space-saving characteristics of this unique *in-line* fan design.

Because Joy AXIVANE Fans can be installed *in the duct*, they may be located in any part of a plane that has ducting. Light-alloy magnesium and aluminum construction save weight but give the greatest vibration-resisting and shock-resisting strength.

FROM 20 CFM TO OVER 6000 CFM is the range of ratings of Joy AXIVANE Aircraft Fans . . . in weights from 10 ounces to 50 pounds. Joy Axivane Aircraft Fans are working, today, in Grumman, North American, Douglas, Martin, and Sikorsky Aircraft. You can put them to work in yours, too. For details write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 124-59

ALL JOY AXIVANE AIRCRAFT FAN DESIGNS ARE BUILT TO CONFORM TO ARMY AND NAVY SPECIFICATIONS . . . WITH OVER 90 STANDARD MODELS AVAILABLE IN A LARGE RANGE OF PERFORMANCE . . . CUSTOM DESIGNS AVAILABLE ON REQUEST.

Consult a Joy Engineer

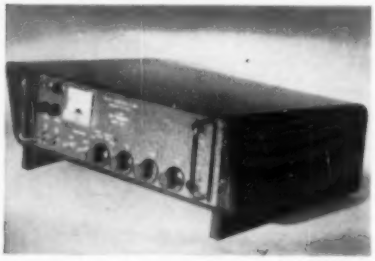
WSW A-6248-124

JOY

WORLD'S LARGEST MANUFACTURER OF VANE-AXIAL FANS

output of 210 kw. and is operationally similar to Type 4J50 fixed frequency tube.

• **Traveling wave tube amplifier,** Model 510A, has output of 10 mw. over 2 to 4 kmc. band and a VSWR less than 2:1. When amplitude modulated by grid, amplifier operates from 0 to 100 mc., has 5 millimicrosecond pulse rise time at maximum power output and a



pulse delay of approximately 15 millimicroseconds. When phase-modulated by helix, amplifier has bandwidth from 10 cps. to 10 mc. and requires 30 volts input for 180 deg. phase shift. Bench model (shown) is priced at $1,135. Rack model costs $1,095. Wave/Particle Corp., 850 Kaynyne St., Redwood City, Calif.

Computers & Data Processing

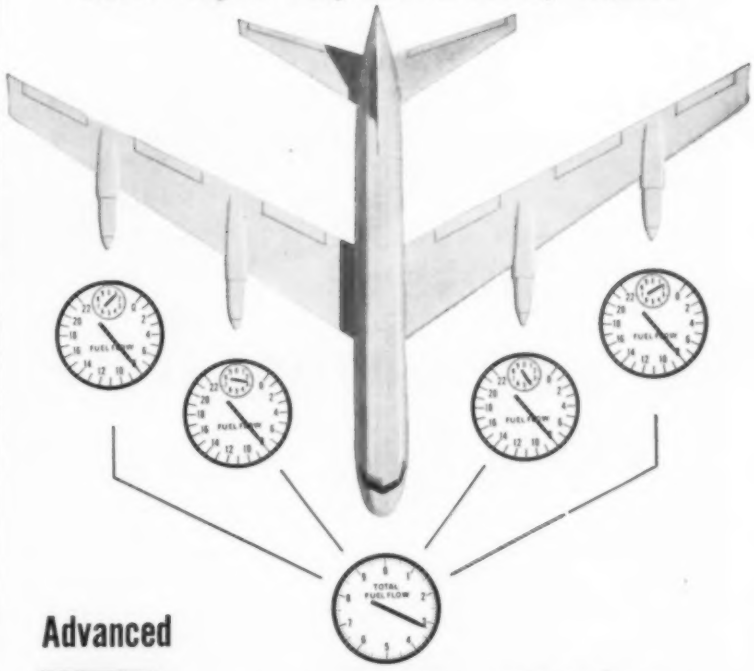
• **Converter for use with X-Y plotter,** accepts input from punched paper tape obtained directly from output of a dig-

ital computer, extracts desired data for plotting. Converter accuracy is 0.1%. Librascope, Inc., Glendale 1, Calif.

• **General purpose simulators,** Models GPS-6 and GPS-12, operate at speeds 3,000 times faster than real time. Wide variety of linear and non-linear computing elements and special function generators are available. GPS Instrument Co., 811 Boylston St., Boston, Mass.

• **Diode function generator,** Type DFG 401, five-channel, capable of generating two or more variables, for use with analog computers. Flexible switching arrangement allows the number of segments in each channel to be varied according to function being generated. Built-in calibration circuit permits quick

Better way to keep tab on thirsty engines



Advanced

Bendix FUEL FLOW TOTALIZING SYSTEM

TYPE 9130

makes news because it . . .

- Is designed for commercial and military jet and piston aircraft—both multiple and single engine.
- Reports fuel consumption from 400 to 2,250 PPH* for individual engines (Type 37100 Indicator) . . . and total consumption for all engines (Type 36722 or 36750 Indicator).
- Provides system accuracy of 2% individual rate and 3% total rate.
- Is pressure tested to 1600 psi.
- Has low pressure drop—only 1.0 psi.
- Is simple to install and service.

*Other ranges available.

Development of new, faster—and thirstier—commercial and military aircraft makes it more essential than ever to have complete and accurate indication of fuel consumption. This new Bendix Fuel Flowmeter System features fuel flow transmitters and indicators *specially developed* for today's—and tomorrow's—greater needs. For full details check with PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

P-C offers qualified engineers challenging, profitable careers

West Coast Office: 117 E. Providencia Avenue, Burbank, California
Export Sales and Service: Bendix International Division, 205 E. 42nd Street, New York 17, New York
Canadian Distributor: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal, Quebec

Pioneer-Central DIVISION

Bendix AVIATION CORPORATION

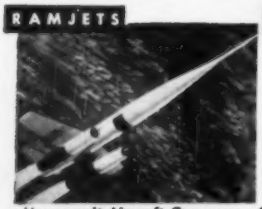
rockets give helicopters extra lift

Reaction Motors, developer and producer of rocket engines and powerplant systems for guided missiles, aircraft, and ordnance-type rockets, is an important participant in the OMAR program. With Marquardt Aircraft, the West's largest jet engine research and development center, and Olin Mathieson Chemical, RMI contributes to a continuous joint technical effort to advance the science and technology of supersonic powerplants and fuels.

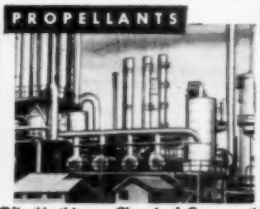
The OMAR program illustrates the integration of effort by a well-coordinated industrial team . . . the weapons systems concept in action. This combination of technical and production skills, products, services, and corporate strength has the capacity to provide an effective assist to those responsible for the common defense.

Engineers, chemists, physicists, production and tool specialists . . . a wide variety of fascinating careers await you on this weapons systems team. For information write OMAR Employment Officer at the company nearest you.

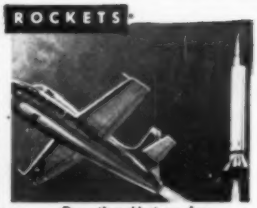
Tiny rotor-tip rocket engines increase the payload of the Sikorsky HRS-2 helicopter up to 100 per cent. Having started their vertical take-offs at same instant, equally heavily loaded Marine helicopters demonstrate relative hovering capabilities. Standard HRS-2 (background) hovers only as high as ground effect will permit. ROR (rocket-on-rotor) helicopter climbed straight up through ground effect and was still climbing when this photo was taken. Developed by Reaction Motors, Inc., for the Navy, ROR provides auxiliary power for take-off or emergency situations.



Marquardt Aircraft Company
Van Nuys, California



Olin Mathieson Chemical Corporation
New York, New York



Reaction Motors, Inc.
Denville, New Jersey

MARQUARDT AIRCRAFT
OLIN MATHIESON CHEMICAL
REACTION MOTORS

OMAR

set-up from a simple plot of the function without using external plotting board. Reeves Instrument Corp., 215 East 91st St., New York 28, N. Y.

New Avionic Bulletins

• **Magnetic tape recording systems,** multichannel miniature type. Project Digest No. PD-21. Cook Electric Co., 2700 North Southport Ave., Chicago 14, Ill.

• **Printed circuit connectors,** for 1/16, 3/32 and 1/8 in. printed boards, are described in 12-page brochure. DeJur Amsco Corp., Electronic Sales Div., 45-01 Northern Blvd., Long Island City 1, N. Y.

• **Analog-to-digital converters,** available with counts up to 543,288. Bulletin No. 372. Norden-Ketay Corp., 99 Park Ave., New York, N. Y.

• **Subminiature relay,** DPDT type, hermetically sealed. Bulletin GEA-6412. (2 pp.) Microminiature relay is described in 8-page bulletin GEA-6346A. General Electric Co., Schenectady 5, N. Y.

• **"Electronic Cable as a Systems Component"** is title of 4-page bulletin available from Pacific Automation Products, Inc., 1000 Air Way, Glendale, Calif.

• **UHF and microwave test equipment** catalog, 28 pages. The Nardo Corp., 160 Herricks Road, Mineola, N. Y.

• **Precision rotary switches** and precision wire wound resistors are described in two catalogs available from The Daven Co., Newark, N. J.

• **Automatic Control for aerodynamic research** and testing facilities, Bulletin MSP-133. (20 pp.) Hagan Corp., 323 Fourth Ave., Pittsburgh 30, Pa.

• **Helipot Series 5600 precision pot,** 2-in. dia., for servo or bushing mounting. Data Sheet 54-49. Data Sheet 54-39 describes Series 500 1¼ in. dia. helipot. Helipot Technical Information Service, Newport Beach, Calif.

• **Ferramic magnetic cores,** specifications and data. Bulletin MT-104. (4 pp.) General Ceramic Corp., Keasbey, N. J.

• **Automatic instrumentation** components and systems are described in new technical bulletin folder No. 716. Fairchild Electrotechnics Div., Fairchild Engine & Airplane Corp., 118 East 16th St., Costa Mesa, Calif.

• **Ruggedized TV camera,** Model PD-152, specification sheet (2 pp.). General Precision Laboratory, 63 Bedford Road, Pleasantville, N. Y.

• **Data transmission system,** Model 111. Bulletin 494, (16 pp.) Beckman Instruments, Inc., Scientific Instruments Div., 2500 Fullerton Road, Fullerton, Calif.

• **Ferrite isolators,** Faraday rotation, transverse field, and differential phase shift types. Bulletin W-103. (4 pp.) Kearfott Co., Inc., Western Div., 253 No. Vinedo Ave., Pasadena, Calif.

• **VHF communications receiver,** Model R 5200, AM and FM covering 50 to 200 mc. band. Bulletin TDS 5200 (2 pp.). Servo Corporation of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

• **"Application of Magnetic Techniques to a Reliable 40 kc. EPUT Meter Design,"** copy of paper delivered at National Institute of Radio Engineers convention. Ask for Data File No. 109. Berkeley Division of Teckman Instruments, Inc., Dept. 535, 2200 Wright Ave., Richmond, Calif.

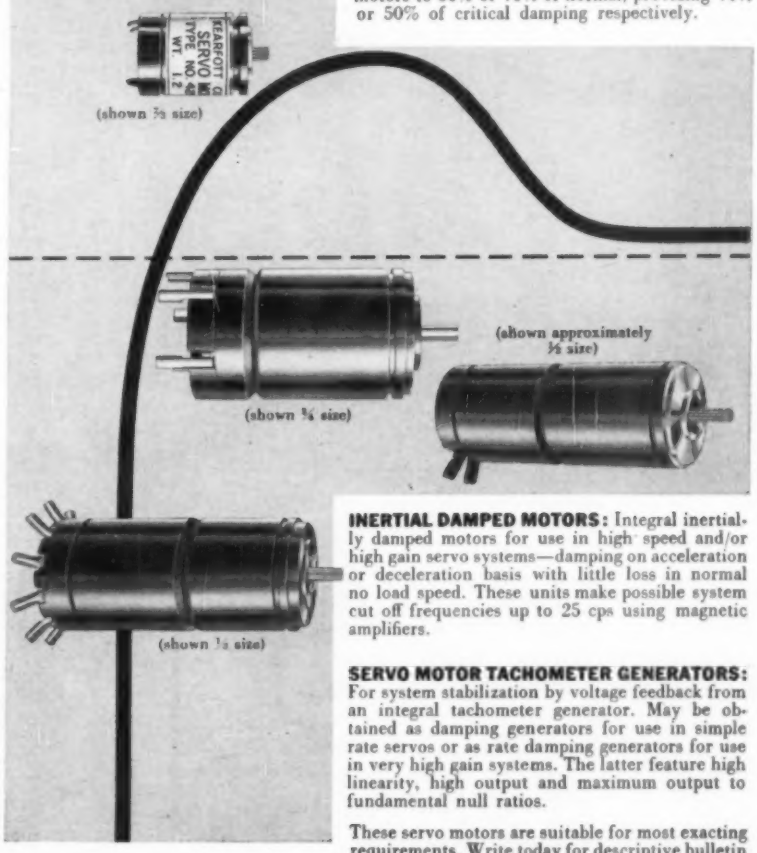
• **Signal generator and control system** for audio frequency response measurements, vibration testing, distortion and acoustical measurements. (8 pp.) Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

• **"Discharge of Corona Current from Points on Aircraft or on the Ground,"** Report No. C.A.L. 66, is available from Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

•**Ruggedized miniature tubes,** guaranteed for minimum of 10,000 hours, made by L. M. Ericsson of Sweden, are described in new catalog available from State Laboratories, Inc., 649 Broadway, New York 12, N. Y.

There is no one "cure all" for system instability. The desired stability of a servo loop is attained through the proper selection of components that satisfy the various conditions under which the loop will operate. Kearfott offers four basic motors and combinations for providing system stability. All feature high speed of response; low inertia and high stall torque.

SYSTEM STABILITY



SERVO MOTORS: Servo motors with high torque to inertia characteristics possessing (built-in) inherent damping ranging in size from ¾" to 1¾" diameter are available. Low speed, low power motors for use in simple instrument servos where high damping and/or low time constant is required can also be provided.

VISCOUS DAMPED SERVO MOTORS: Provide integral viscous damping for simple instrument servos. Any degree of damping can be provided. These units reduce no load speed of standard motors to 50% or 75% of normal, providing 70% or 50% of critical damping respectively.

INERTIAL DAMPED MOTORS: Integral inertially damped motors for use in high speed and/or high gain servo systems—damping on acceleration or deceleration basis with little loss in normal no load speed. These units make possible system cut off frequencies up to 25 cps using magnetic amplifiers.

SERVO MOTOR TACHOMETER GENERATORS: For system stabilization by voltage feedback from an integral tachometer generator. May be obtained as damping generators for use in simple rate servos or as rate damping generators for use in very high gain systems. The latter feature high linearity, high output and maximum output to fundamental null ratios.

These servo motors are suitable for most exacting requirements. Write today for descriptive bulletin giving data of components of interest to you.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Kearfott

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KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.

Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas

West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

TWIN COACH

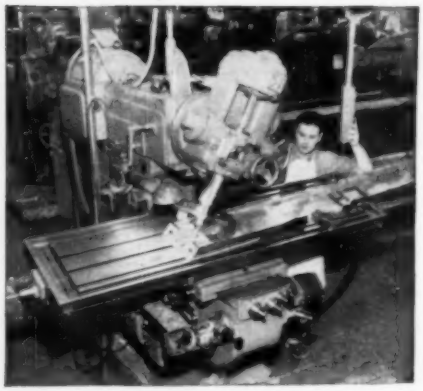
helps give the Sabre its edge

Famed for its combat superiority with the United Nations in the skies over Korea, the Sabre Jet is now being supplied to other NATO countries.

Twin Coach Aircraft Division was selected as a subcontractor for large and intricate machinings for the F-86 as well as for North American Aviation's other high-performance aircraft, the F-100 and FJ4.

These important assignments are typical of the way in which leading airframe manufacturers rely on Twin Coach as a source of major airframe assemblies.

If you have an assembly you're considering subcontracting, call Twin Coach for consultation. Our *aircraft* experience . . . our 23½ acres of plant and facilities are at your disposal.



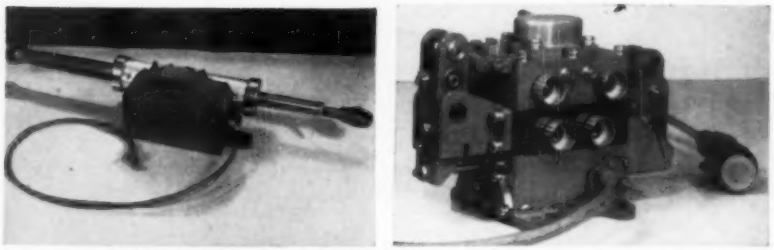
Twin Coach Aircraft Division plants turn out wing spars, main wing panels, flaps, complete center sections with plumbing and electrical wiring, and other large assemblies.

OTHER DIVISIONS OF TWIN COACH COMPANY MAKE: *Fageol Van and Pony Express Trucks, Fageol Gasoline and Propane Engines, Fageol-Leyland Diesel Engines.*

TWIN COACH COMPANY

Aircraft Division BUFFALO, N.Y.

TWIN COACH AIRCRAFT DIVISION MAKES ASSEMBLIES FOR BOEING, CESSNA, GRUMMAN, NORTH AMERICAN, REPUBLIC, AND CLASSIFIED EXPERIMENTAL AIRCRAFT TYPES. AA-1159



HYDRAULIC RESEARCH'S servo valve (left) shown attached to control actuator. Moog multiple input servo valve (right) is in production for fighter application.

Two New Servo Valves Integrate Automatic Control, Pilot's Input

Los Angeles—New concept in integration of automatic flight control and stabilization with pilot's manual input has been incorporated in two servo valves developed independently for high speed aircraft.

These units have been designed to provide:

- **Improved control** response.
- **Decreased complexity** in control actuation mechanism, leading to increased reliability.
- **Weight and space** saving by elimination of separate control components and substitution of a single integrated package.

It is estimated that 20-40 lb. can be saved by adoption of the integrated package to the three control axes—roll, yaw and pitch.

One of these units has been developed by Moog Valve Co., Inc., East Aurora, N. Y., and is in production for high-performance fighters.

Pilot Production

The other unit, developed by Bell Aircraft Corp., has been licensed for manufacture by the company's subsidiary, Hydraulic Research & Mfg. Co., Burbank, Calif. This unit, known as the Hydromat, is in pilot production. It also is for high-performance fighter application.

Each unit is a multiple input electro-hydraulic servo valve which receives electrical inputs from stabilization and autopilot amplifiers, as well as the manual input from the pilot's control stick.

Servo Valve Reaction

The servo valve reacts this way in the three distinct modes of operation:

- **Pilot's manual input** positions the valve spool, which in turn operates an hydraulic actuator to move the control surface. In performing this function, the servo valve acts as a conventional power control valve.
- **Autopilot control** is accomplished by introducing electrical signals from the airplane attitude reference system to an electro-hydraulic amplifier. This locks out the pilot's input and applies a pressure across the power control spool, which varies the flow to the main surface actuator. Resulting surface movement provides the flight path control.
- **Airplane stabilization** beyond the capability of the pilot in high speed flight is accomplished by reception of an electrical signal from the rate gyro for the particular axis, superimposed on the pilot's manual control input.

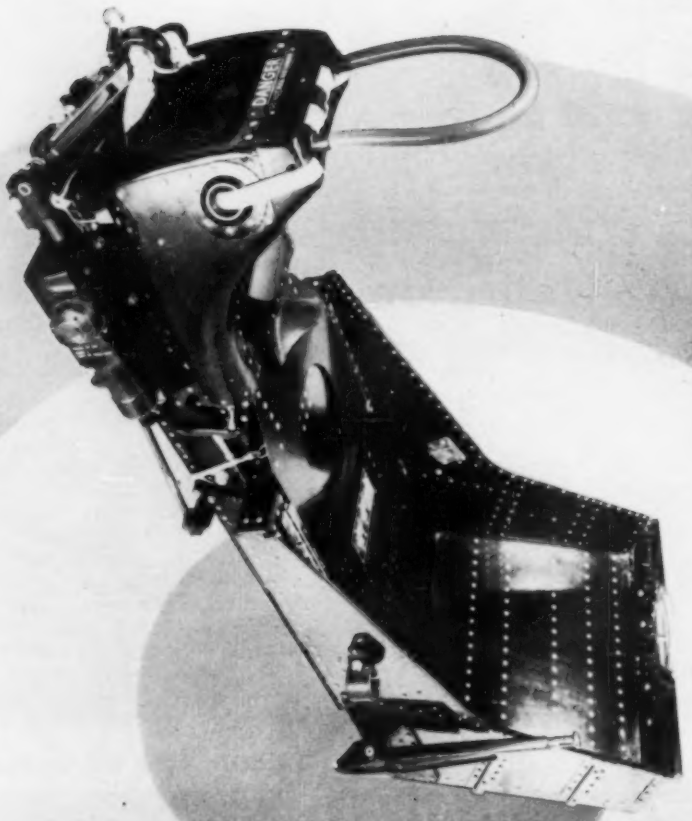
The resulting hydraulic output from the servo valve provides the necessary damping in addition to the normal flight control.

Both the Moog and the Hydraulic

Soviet Air Division Goes Home

Seventy Russian U-Il-28 trainers (foreground) and Il-28 bombers (second plane, with bombardier nose) are prepared for takeoff from Oranienburg air base in East Germany. Planes, belonging to 221st Soviet Air Division, were sent home as part of Soviet demobilization campaign.

The illustration is of a Mark A4 fully automatic ejection seat as supplied to Aeronautica Macchi of Italy.



The ejection seat used by air forces of **26** nations.

MARTIN-BAKER AIRCRAFT COMPANY LIMITED

ENGLAND — CANADA

Research units use the electro-hydraulic amplifier (flapper valve) to convert the rate gyro electrical signal to hydraulic pressure.

Basic operational difference between the Moog and Hydraulic Research units lies in the method of superimposing (summation of) the rate gyro signal on the pilot's manual input.

In the Moog unit, summation is accomplished by adding, to the mechanical displacement of the power control spool centering spring, the movement generated by the control pressure from the electro-hydraulic amplifier.

In the Hydraulic Research unit, summation is accomplished by adding, in the hydraulic amplifier, the forces generated by the rate gyro signal and the pilot's input motion.

Difference here between the two units is simply one of design approach.

THIS Carmody Corp. Procedure Trainer, duplicating Grumman's supersonic F11F-1, teaches pilots how to eject, cope with flame-outs, and familiarizes them with the cockpit.

Naval Center Develops Training Devices for Use by Services

Port Washington, N. Y.—The growing importance of training devices to the military services is underscored by this recent statement made by a U.S. Navy fleet commander: "From now on, I want a training device for every piece of equipment delivered to me."

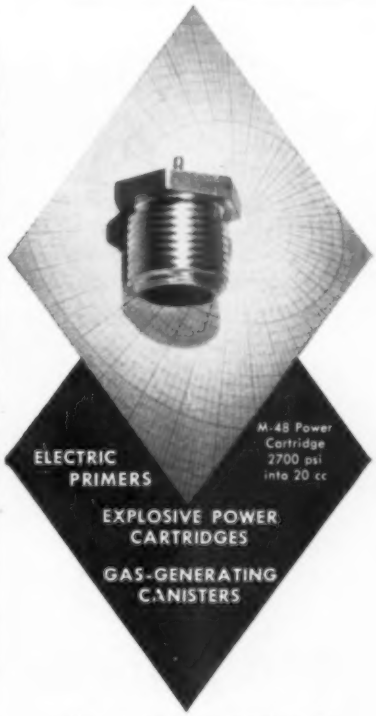
To translate the commander's demand into practical hardware will become another task for the U.S. Naval Training Device Center which recently celebrated its tenth anniversary at its headquarters here in the medieval castle-like stone buildings of the former Guggenheim estate.

Training devices are beginning to hold an equally important place in civilian organizations. Example is Link Corp.'s plan to deliver an electronic flight simulator for the Douglas DC-8 before the jet transport flies. This will mark the first time that a simulator has been available prior to the flight of the aircraft which it was designed to simulate—stressing the importance of having a training device at hand before placing a complicated new piece of hardware into operation.

The establishment, which until a few months ago was called the Special Devices Center, (AW Sept. 26, 1955, p. 35), has the responsibility of developing—with industry—training units requested by the five agencies responsible for all Navy training. The devices are used to train men who work and fight in the air, on the sea, under the sea, and on land.

Although initially almost 100% of the devices developed were in the field of aviation, today approximately half of the center's funds go into surface and sub-surface training equipment while an increasing portion of production funds are provided for non-aviation equipment. The center also does

SQUIB SPECIALISTS



An organization specializing in the design, development, and manufacture of explosive ordnance, McCormick Selph places first emphasis on dependability. The entire group is located in a 60,000-sq-ft plant on a 200-acre site having perhaps the most complete facilities of its kind in existence.

Your procurement and reliability problems in specialized explosives* can probably be solved at McCormick Selph — either with standard items, tried and proved, or with units produced to meet your specific need.

Send for data or submit your problems to:

* Ignition Actuation Ejection Fracturing

McCORMICK SELPH ASSOCIATES
HOLLISTER 1, CALIFORNIA

A NEW NWL *Lift* LINE...

HIGH TEMPERATURE ACTUATOR

NOW hydraulic actuators operating in areas of...

... 800° F

It is now possible for you to incorporate the advantages of *hydraulics* in high temperature areas on jet engines and airframes. NWL design developments in the seals and internal configuration of the new Lift Line High Temperature Actuators are making possible such units as the pictured synchronous afterburner actuator.

SYNCHRONOUS ACTUATION . . .
. . . between two or more units is achieved through internal gearing and screw arrangements, inter-connected by flex shafting. Inter-positional relationship is maintained to thousandths of an inch. Adjustable stops, fail-safe locking, lightness of weight and selective intermediate positioning are features of this line.

ACTUATOR SPECIFICATIONS . . .
Operating Pressure: 50 to 5,000 psi; *Temperature Range:* (ambient) —65° to 500° F., (extended rod) 800° F.+, (oil) —65° to 400° F.; and *Rated Loads:* available to your specifications.

ADDITIONAL SPECIFICATIONS . . .
. . . and assistance in applying NWL engineering and quantity precision-production facilities and techniques to your high temperature problems, are available from local NWL sales-engineers and engineering project teams.

other new *Lift* line products . . .

ELECTRO-HYDRAULIC METERING VALVE

UNICON

HIGH TEMPERATURE SERVO ACTUATOR

SERVO VALVE

NATIONAL WATER LIFT COMPANY
DIVISION OF CLEVELAND PNEUMATIC TOOL COMPANY
2220 PALMER AVE. KALAMAZOO, MICHIGAN

The *Lift* LINE

training research for the Army, and has an Air Force liaison officer who monitors training device research and development for the USAF.

Among the many active programs currently under way at the center are: Research into nuclear powered aircraft (which Capt. C. H. S. Murphy, the center's commanding officer and director termed a "very active investigation") and a digital computer—being developed with the USAF and the University of Pennsylvania—to replace analog computers.

The computer will bring great flexibility and economy to simulators because, being digital, they can be made to duplicate the characteristics of several different aircraft. Today's analog computers can only be tailor-made to simulate the characteristics of a single plane.

Another active program is the development of procedure trainers (AW Mar. 28, 1955, p. 58) which cost about one tenth the price of electronic simulators and can effectively train men in such vital operations as ejection and in-flight engine relight in case of flame-out. The center now has an F11F-1 procedure trainer built by Carmody Corp.

Among other achievements of the center are a helicopter flight simulator, developed by Bell Aircraft Corp., an ejection seat trainer, developed and built by All American Engineering, Inc., and a P5M-1 mobile flight trainer. The latter, housed in two 40-ft. road trailers, is the most complex unit of its kind ever built, according to the Navy.

The center also had a hand in developing two Fleet Air Defense Training Centers, one on each coast, with which realistic battles are fought. As Capt. Murphy said, "some day machines may be developed which will select admirals."

OFF THE LINE

Beech Aircraft Co., which had just received USAF contract for MD-3 ground support units, has obtained a $203,000 Navy order for a similar unit for starting jet aircraft, the Model 316 power unit.

The self-propelled generator powered by 160 hp. engine and containing its own control box, instrument panel, heating and cooling system, is primarily designed for starting the F2H-4, AD-5N and F9F.

First executive-type aircraft to be equipped with tubeless tires are twin-engine Beechcraft Super 18s currently rolling off the production line at Wichita, Kan. The planes' main landing gear mount 11.00-12 nylon tubeless tires, wheels and brakes made by the

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He's the PERMADIZING man . . . your nearby Stillman representative with all the answers to your rubber-to-metal bonding problems. Ask him about PERMADIZING, the exclusive Stillman high-quality rubber-to-metal bonding process that provides precise, flash-free parts of optical smoothness and allows effective sealing at near-zero pressure. Write or call your nearby Stillman representative today.

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Stillman has the answer . . .
PERMADIZING

the new **FC-3500** TANK FILLER CAP

★ Removed with only a 35° turn
★ Weighs only .43 lbs.
★ Opens safely under pressure
★ Full 3-inch opening
★ Lever action design

The first tank filler cap to successfully pass all test requirements of MIL-C-7244B (ASG) applicable to fuel, oil, alcohol-water and hydraulic reservoirs. Write for data sheet on this new FC-3500 flush mounted cap.

GABB SPECIAL PRODUCTS
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Now! . . . the NEW
ROBINSON WIRE TWISTER
with DIAGONAL GRIP-HEAD

Faster, more efficient than ever! The new, slendernose DIAGONAL GRIP-HEAD is designed especially for those narrow- hard-to-reach places. Split-second whirling action safety-wires 3 engines in time required for one by any other method . . . saves as much as $140 per engine assembled.

3-TOOLS-IN-1 . . . pliers-cutters-twisters. Side-cutting, oil-tempered head. Permanent bronze bearing. No adjustments. Jaws lock on wire, can't slip off. Perfect, uniform twist every time.

12" —for assembly line safety wiring, 15 oz. **$21.50**
9" —for bench work, sub-assemblies, 12 oz. **$20.50**

Unconditional Money-Back Guarantee. Send for complete details.

RALPH C. ROBINSON CO.
Box 494W No. Sacramento 15, Calif.
Canadian Distributor, Gensales, Ltd., Malton, Ont.

Business flies his way!

E. Merritt (Andy) Anderson, Shell Aviation Dealer at General Mitchell Field, Milwaukee, has a knack for making friends and making money. Maybe that's because he keeps so busy.

Meet Andy Anderson—aircraft salesman. Andy first tried his hand at selling airplanes as a distributor for a popular airplane manufacturer and has consistently been on the "Top Ten" list of leading salesmen for this make.

Meet Andy Anderson—instructor in flying. When you love flying as much as Andy, it's only natural for you to pass on your enthusiasm. So Andy established a glider school and a student training center in Wisconsin plus a primary flying school in Missouri to help hundreds of young pilots.

Meet Andy Anderson—flying ambassador. Andy goes everywhere in his own plane . . . signing up new clients . . . looking after all the Anderson interests.

Meet Andy Anderson—Shell Aviation Dealer. Andy's first big success was with Shell. His company, Anderson Air Activities at General Mitchell Field, Milwaukee, was formed in 1941. Today it's a round-the-clock operation, servicing four major airlines, an Air Force reserve unit, a National Guard squadron and a host of private and corporate planes.

And more and more business keeps flying

Andy's way. It's no wonder! He has a sure-fire sales-building approach—"Give 'em what they want . . . *on-schedule* service."

With a full line of Shell Aviation products in the shop, the very latest Shell equipment on the runways and the Shell Aviation Credit Card system to save the flier even *more* time, AAA is equipped to service anything that flies . . . quickly, efficiently.

For example, the daily routine includes preparing a giant airliner for a "cross-country hop" . . . getting a corporate flier off on schedule for an appointment in Cleveland . . . refueling Air Force jets for patrol duty . . . checking and servicing a private plane before it takes off on a weekend jaunt.

AAA has to keep up with the latest service methods, too. It depends upon frequent visits from the Shell aviation specialist plus merchandising hints in the Shell Dealer magazine to keep abreast of what's new in runway service.

Since he became a Shell Aviation Dealer, Andy has boosted his gallonage almost three thousand per cent. No doubt about it—Andy Anderson sells for Shell and does a fine job. But Andy, himself, has said, "Shell sells for me!" And he can prove it.

With the latest Shell equipment on the runway, AAA gives these Air Force jets quick, efficient service.

Private fliers like the way AAA rolls out the red carpet as soon as they roll in.

AAA (Anderson Air Activities) helps major airlines meet split-second schedules with efficient, *on-schedule* service.

Dependable Shell aviation products in the shop help AAA do an A-1 job on repairs.

It pays to be a Shell Aviation Dealer

—and the Shell office nearest you will be glad to show you why

SHELL

Johns-Manville organizes to give you better insulation service

New and separate insulations division created to provide industry greatly improved Sales and Engineering service to meet modern problems

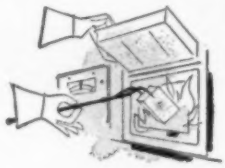
• Johns-Manville is now concentrating all industrial insulation operations within a new, fully integrated insulations division. This greater specialization makes possible the most complete insulation service available to industry. It consists of—

Sales Representatives . . . men on whom you can rely for your insulation recommendations. Your J-M salesman will help you select the insulating material exactly right for your job—the one that will provide maximum fuel savings, improved process control, and minimum maintenance. As co-ordinator of J-M's extensive research-engineering-manufacturing facilities, he offers you outstanding insulation training and experience.

Insulation Engineers—Backing up the J-M salesman on every job is the J-M insulation engineer. He is primarily concerned with solving insulation problems. He recommends the economic thickness of insulation, as well as the proper finishes, weatherproofing and securement. His highly specialized knowledge makes possible an intelligent recognition and handling of your individual insulation requirements.

Insulation Contract Units . . . Fully aware that no insulation is better than the man who applies it, the J-M Insulation Contractor makes care and skill in the scientific application of Johns-Manville insulations his stock in trade. He maintains a complete crew of estimators and mechanics trained in J-M application techniques. He is ready to give you fast, efficient service on any insulation job—large or small. Proud of his reputation for integrity in his own community, the J-M Insulation Contractor merits your complete confidence.

Complete Range of Products—In this day of exacting temperature control, the need for specific insulations for specific services is greater than ever before. Recognizing this, Johns-Manville manufactures insulations for every industrial requirement. Produced from the finest grades of asbestos, magnesium carbonate, diatomaceous silica, refractory clays and ceramic fibers, they are designed to afford maximum insulating effectiveness and durability at operating temperatures ranging from minus 300F to plus 3000F.



Extensive Research Facilities—At Manville, New Jersey, Johns-Manville maintains the world's most completely equipped insulation laboratory. Here insulation scientists are engaged in a continuous program of developing new and better insulating materials. In addition, their technical knowledge is always available to J-M customers whose insulation problems require special study.

Experienced Management—At headquarters as well as in the field, management of the new insulations division consists of men who, in line with J-M's promotion-from-within policy, are insulation veterans. With a realistic grasp of customers' needs, they are alert to new and better ways to serve you . . . now, and in the future.

On Your Next Insulation Job—Whether your next insulation job is big or little, simple or complex, let Johns-Manville handle it for you. Just call your nearest J-M sales office, or write direct to Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. *Chances are, you'll be glad you did!*

Johns-Manville *first-in* **INSULATION**

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If you can do original work

. . . you should consider The Johns Hopkins University Applied Physics Laboratory (APL), where creative ideas are recognized and supported.

The Laboratory is primarily concerned with research and development of guided missile systems. A sizeable program of fundamental research is concurrently in progress.

APL is responsible for technical direction of the Navy's Bumblebee guided missile program. Developments at APL include the first supersonic ramjet, and the missiles TERRIER, TALOS and TARTAR.

A distinguishing feature of the Laboratory is the self-dependence of the professional staff members, who work in an atmosphere of free inquiry and are unhampered by the usual administrative details. Problems are attacked by teams, each of which maintains a fine balance between research and engineering. The team approach allows each member to acquire broad knowledge, find his creativity heightened.

The locations of the Laboratories in the Washington D. C.-Baltimore periphery place staff members near fine housing in all price ranges, recreational and cultural facilities. Moving expenses paid in full. Liberal educational benefits for study at a number of excellent universities nearby.

OPENINGS EXIST IN:

DEVELOPMENT: stability and control analysis; ramjet engine design

RESEARCH: interference and heat transfer phenomena; hypersonics, turbulence, shock wave phenomena

For additional information write:
Professional Staff Appointments

The Johns Hopkins University
Applied Physics Laboratory
8615 Georgia Avenue,
Silver Spring, Md.

Aviation Products div., Goodyear Tire and Rubber Co. Tube weight saving is approximately 40%.

"Spraymat," a Napier-patented, electrically-heated deicing system which is sprayed on to an aircraft between two layers of insulation, will be manufactured in France by Bronzavia, S. A., in its plant at Courbevoie, near Paris. Because it is sprayed on, the material can be applied to any complex shape. It is also light in weight and has high thermal efficiency.

Three prototype models of a Rocket Scoring Camera will be developed by the Reconnaissance Systems division, Fairchild Camera and Instrument Corp. under a contract with Wright Air Development Center. The cameras, which have three-dimensional capability, are designed primarily for air-to-air rocket training use. They also are adaptable for strike recording.

Army Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Army Contracting Offices:

CORPS OF ENGINEERS, U. S. Army, Office of the District Engineer, Mobile District, 2301 Grant St., Mobile, Ala.

Ralph M. Parsons Co., Los Angeles, Calif. Supplemental Agreement No. 2 to Contract DA-01-076-ENG-3274, architect - engineer services under phase 2 for design of ABMA facilities at Redstone Arsenal, Huntsville, Ala., (negotiated), job, $472000.

Butler & Cobbs, Montgomery, Ala., Contract DA-01-076-ENG-3335, additional work in connection with class and laboratory building and shop buildings at Redstone Arsenal, Huntsville, Ala., (IFB ENG-01-076-56-75B, job, $119118.

LOS ANGELES ORDNANCE DISTRICT, 55 S. Grand Ave., Pasadena, Calif.

Harvey Machine Co., Inc., 19200 S. Western Ave., Torrance, Calif., development of 2-in. rocket motor parts manufacture, job, $152136.

Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif., accumulator, hydraulic, assy, (bladder type) mfr's part no. BVC-1005190, job, $36988.

Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, Calif., Honest John task type contract, job, $25000.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

BUREAU OF ORDNANCE, Washington, D. C.

Convair, Div. of General Dynamics Corp., Pomona, Calif., CAG vibration and shock measurements, NOrd-16973, $81946.

Oliver Corp., Shelbyville, Ill., guided missile reusable shipping containers, BUORFD LD 288419; 480709; 288912; 288903; 288958, NOrd-17077, IFB 600-865-56-0, 1260, $2115058.

NAVAL AIR MATERIAL CENTER, Naval Base, Philadelphia 12, Pa.

Bethlehem Steel Co., Bethlehem, Pa., alloy steel bar, rough turned, Mil spec MIL-S-890 (ships) amend 2 approx. size 28" dia. x 16½" long, 26 pcs., IFB neg. 156/251086/56Q (N156s-33174), 76322 lbs., $26,712.

Acme Aluminum Alloys, Inc., 215 North

designers
do you have a "special" MOUNTING BASE PROBLEM?
Call in Finn. Here's a short story of two who did

ONE COMPANY isolated a delicate gyro amplifier with this unusual base. Finn-designed, it licked crucial space and weight problems with its lightweight construction and sub-miniature Finn Mounts. To MIL-C 172-B, it has company and Air Force approvals.

These are only two examples of the technical skill, experience and facilities available at Finn. An approved source, Finn can lick your "tough specials" at a competitive price. What's more, many "special" and standard mounting bases are stocked for immediate delivery.

LEAR, INC. fitted an auto pilot component way up in the TF-102's nose with this Finn base. Space envelope was extremely critical; hence, sub-miniature Finn Mounts and space-saving design. Approvals: Lear, Inc., Air Force, Air Frame. To MIL-C 172-B, of course.

For more information, write to the address below. Or call HAwthorne 7-4100

FINN
ELECTRONICS DIVISION
T. R. FINN & Company, Inc.
200 Central Ave., Hawthorne, N. J.
Pioneers in Lightweight Mounting Bases

Findlay Street, Dayton 3, Ohio, runway barrier, type MA-1A, USAF drawing 55J6348 (less chain and shackles), IFB Neg 156/251373/57Q (M156s-33229), 20 prs., $256,080.

Schiller Nolan & Co., Inc., 817 Wood St., Philadelphia 7, Pa., services to manufacture firing piston, stainless steel, aeronautical medical equipment lab. dwg. AMEL 582, rev. 1, Mil. Spec. MIL-S-7742 AMEL pt. no. 582-4, IFB neg. 156/251329/56Q (N156s-33227), 7,000 ea., $47,250.

NAVY PURCHASING OFFICE, Washington, D. C., 4th & Independence Ave., S. W., Washington, D. C.

H. L. Yoh Co., Inc., 311 Walnut St., Philadelphia, Pa., plans and specifications for a 30000 lb. thrust cap., class "C" fleet maintenance turbo-jet engine test facility, (N600(A)41794) (Neg. 801-56Q) 1 1 1 1 Lot, $37578.

Lee Engineering Co., 269 Armistice Blvd., Pawtucket, R. I., aircraft tire bead breaker, presto model jet, (N600(A)41777) (Neg. 895-56Q), 300 ea, $85800.

Last Flights

Two familiar profiles are about to drop out of the aircraft recognition handbooks. The T-6 trainer (top, background), the last in use by the Air Force, was officially retired at Bartow Air Base, Fla., recently. Here it flies with the T-28, which is its replacement. The North American trainer still is in service with the Navy, but the SNJ version also is being retired. Below, the Marianas Mars taxis down the seaplane runway with Diamond Head in the background ready to make the last Hawaii-to-California flight of the Mars fleet. R3Y Tradewind turboprop seaplanes of Transport Squadron 2 will replace the Marianas Mars, and her sister ships, the Hawaii, Philippine and Caroline Mars. One Mars, the Marshall Mars, was lost on a test flight in 1950, but the crew escaped without injury before the plane burned and sank.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

SACRAMENTO AIR MATERIEL AREA, McClellan Air Force Base, McClellan, Calif.

Lear Incorporated, Grand Rapids, Mich., rotary actuator #189BD, 12 ea rotary actuator, 30 ea rotary actuator (end use classified), 43 ea (P/R 23580), $86835.

North American Aviation, Incorporated, P. O. Box 95, Fresno, Calif., storage and accomplishment of transfer inspection and various modifications of 59 F-86D type aircraft, (P/R 338 and 338-1), $50159.

Consolidated Diesel Electric Corporation, Ludlow and Canal Street, Stamford, Conn., control gen manual, P/N 8211-1700-691-1, 24 ea; case assy, P/N 8211-200;-002, 47 ea; control gen manual, P/N 8211-2001-176, 34 ea; applicable C26, MA1 & MD3 generator sets, (P/R 5204, 5205 and 5205-1), $470096.

O. E. Szekely & Associates, Inc., Commerce, Ga., fan elec, P/N 8211-235-1012, 60 ea; hose air duct, P/N 8211-235-1057-2, 500 ea; hose air duct, P/N 8211-235-1057-24, 700 ea, applicable C-26 & MD-3 generator sets, (P/R 5241), $28384.

General Electric Company, 235 Montgomery St., San Francisco, Calif., generator DC, P/N 8211-1700-2041, 24 ea; applicable to MA-1 Generator sets, (P/R 5218), $213947.

OFFICE OF SCIENTIFIC RESEARCH, Air Research and Development Command, Post Office Box 1395, Baltimore 3, Md.

The Johns Hopkins University, Institute for Cooperative Research, Whitehead Hall, Baltimore 18, Md., research, continuation on combustion rates in fuel-aerosol vapor mixtures (AF18(600)-1176), job, $37012.

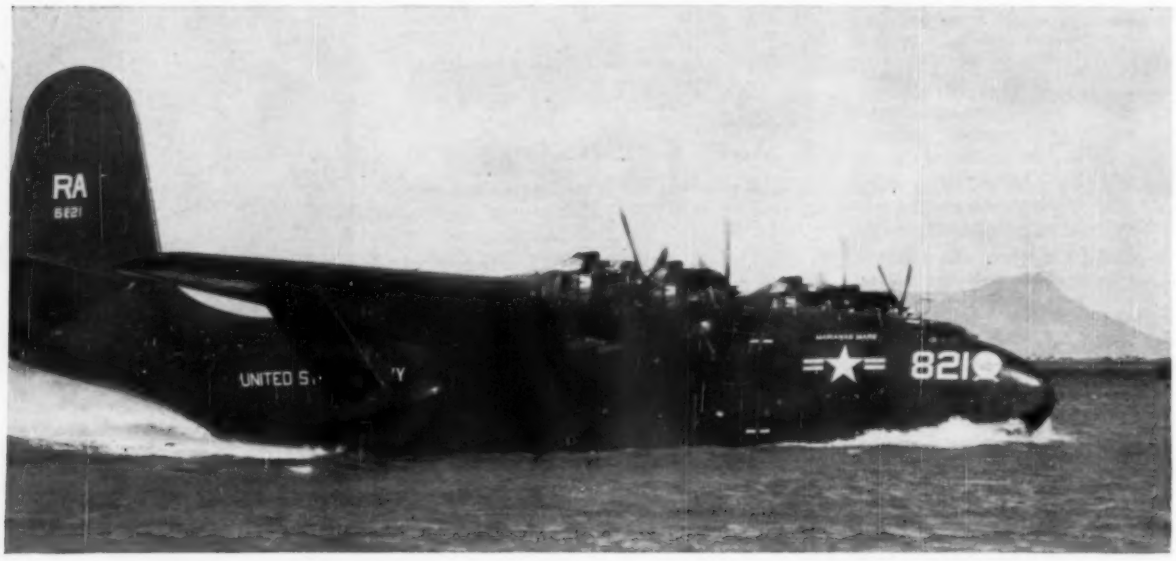
Reed Research Incorporated, 1048 Potomac Street, N. W., Washington 7, D. C., research, analysis of turbulent heat transfer to liquid metals (AF18(603)-104), job, $27145.

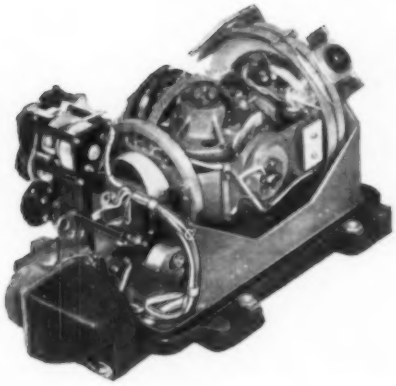
California Institute of Technology, Pasadena 4, Calif., research (Panel Flutter) (AF18(600)-1142), job, $25522.

MIDDLETOWN AIR MATERIEL AREA, Olmsted Air Force Base, Middletown, Pa.

Aerodex, Inc., P. O. Box 123, International Airport Branch, Miami 48, Fla., repair and rework of exhaust valves applicable to R-3350 series aircraft engines, 4550 ea, $54509, RFP PR MA-598823.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., meters, 1701 ea, $47302, RFP PR MA 718556.





This is a Cageable Vertical Gyro—the brain of Honeywell's Low Altitude Bombing System. Known as LABS, the system makes possible the automatic and accurate delivery of nuclear bombs. Honeywell is the largest supplier of these automatic bombing systems for the Navy and Air Force.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL

Rascal "no time over the target"

High in the atmosphere, a huge U.S. Air Force bomber wheels. As it changes direction, a long shape separates from the bomber. Rocket engine firing, the shape accelerates to high speed and vanishes into the distance... an air-to-surface missile on its swift way to a far-off target.

This, in brief, is the mission of the GAM-63 Rascal guided missile—designed, developed and produced for the U. S. Air Force by Bell Aircraft Corporation.

Rascal is a long range, air-to-surface missile which accomplishes its mission without exposing the bomber aircraft to concentrated local defense. Rascal can be launched and proceed to its destination while the bomber is on its homeward flight, thus sparing aircraft and crewmen the critical "time over the target."

The guidance system which controls Rascal is close to human intelligence and operates just as if a pilot were riding in the nose of this missile. Rascal is propelled at its tremendous speeds by a rocket engine also developed by Bell.

Rascal encompasses one of the broad concepts of Air Force missile programming and Bell Aircraft has applied all the skills of its vast scientific and engineering team in the development of this strategic weapon system.

The Air Force-Industry team urgently needs scientists and engineers for projects vital to the nation's defense. Opportunities to make important contributions are offered in military or civilian careers.

BELL Aircraft CORP.

BUFFALO, N. Y.

ENGINEERING BULLETIN

ON MICRO-BEARINGS

Miniature Instrument Ball Bearings

NEW HAMPSHIRE BALL BEARINGS, INC.

PETERBOROUGH 1, NEW HAMPSHIRE

Subject: **FACTORS TO CONSIDER IN MINIATURE BEARING APPLICATION**

TYPES OF BEARING

The Retainer Bearing fitted with the one-piece crown retainer is well suited for the great majority of instrument applications. Even ball spacing produces good performance at low-moderate speeds, and it can also handle radial or thrust loads. Improved fabricating techniques result in crown retainers being specified for low-torque requirements.

Phenolic Retainers machined from phenolic plastic allow higher speeds and also provide some retention of lubricant. This retainer is used with angular contact bearings where one land is ground away from the inner or outer ring to permit bearing assembly. Such a design permits thrust *only* in the direction of the side having the full land.

CROWN

PHENOLIC

The Full Bearing has a full complement of balls. Filling notches are ground on one side of each ring to allow assembly. This type is steadily being replaced by retainer bearings which cost less to manufacture and assemble. It has an advantage for certain applications requiring maximum radial load capacity, but is unable to handle thrust loads because of possible interference between the balls and filling notches. Contact between the balls creates friction which makes the full bearing unsuitable for low torque or high speed applications.

MATERIALS

Stainless Steel's anti-corrosive properties have made it first choice for bearings used in precision instruments, and it has become one of the standard materials for this purpose. It can be ground and finished to a high degree of precision.

Chrome Steel should only be specified when bearings must operate at critical limits of capacity, a condition not often encountered in instruments. It has a somewhat higher load rating than stainless steel but is subject to rapid corrosion if not protected during handling and use.

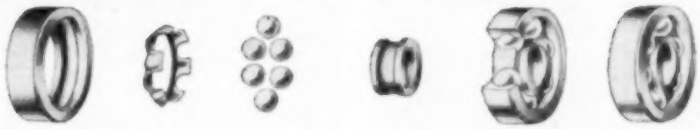
Beryllium Copper should be restricted to applications which definitely require non-magnetic properties in the bearings. All components of the bearing are fabricated from this material. If non-magnetic properties are not required, stainless steel is a better selection.

LOAD RATINGS

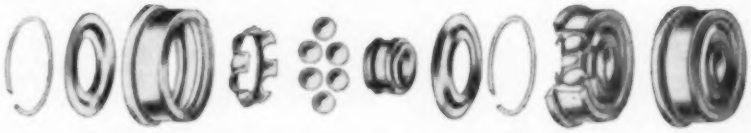
A miniature bearing is seldom operated at or near its rated load capacity. However, the designer must have sufficient information to assure intelligent selection. The load ratings presented in the New Hampshire Ball Bearings, Inc. catalog tables are based on standards established by the AFBMA after extensive studies and tests.

Dynamic load ratings apply to bearings that are rotating. Time-consuming calculations can be avoided by making use of the C factor shown in our catalog.

Static load ratings apply to bearings at rest. Since this exists in relatively few cases, static load rating is not usually given much emphasis. Formulae have been developed, however, and the need for this information is increasing, — primarily for units subjected to shock loading.



Retainer Bearing — Exploded and Assembled Views



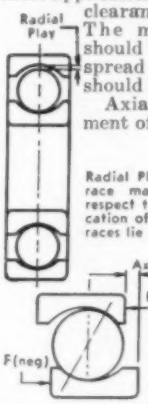
Retainer Bearing — Flanged and Shielded

RADIAL AND AXIAL PLAY

Radial play is the displacement of one ring with respect to the other along the *diameter* of the bearing.

It is important in the successful application of precision bearings and should be specified in orders. A range of .0002" to .0005" is satisfactory for most applications but tighter or looser clearances may be required. The minimum clearance should be .0001" and the total spread from min. to max. should be at least .0002".

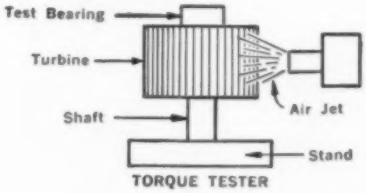
Axial play is the displacement of one ring with respect to the other along the bearing axis. It is specified only when axial positioning of the shaft must be held within certain limits. Radial and axial play are mutually dependent factors and the former is the one usually specified.


Radial Play
Radial Play — Maximum distance one race may move diametrically with respect to the other without the application of measurable force when both races lie in the same plane.
Axial Play
2
F(neg)
F(neg)
Axial Play — The maximum relative axial movement of inner race with respect to the outer, when both races are coaxially centered, without the application of measurable force.

TORQUE TESTS

Sensitive instruments require bearings with minimum inherent friction. Starting, or breakaway, torque is most often used to define limits. This is the force necessary to induce rotation from standstill under clearly established conditions of mounting and loading.

Torque tests can reveal much about the true quality and geometry of the bearing. Investigations being conducted constantly are producing valuable contributions to the refinement of instrument bearings.



TORQUE TESTER

MOUNTING PRACTICE

An improper fit to the shaft or housing can cause malfunctioning and failure of a precision bearing. The factors vary so with each application that bearing manufacturers are reluctant to make definite recommendations unless adequate information is furnished. The user cannot be sure that he has selected proper fits unless he has considered the variables involved in the manufacture of both instruments and bearings.

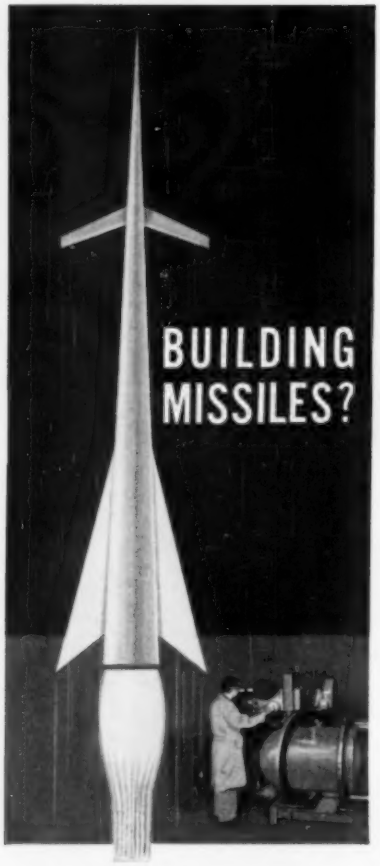
For selective assembly "coded bearings" can be supplied. This involves sorting bores and outside diameters in .0001" increments. It produces four possible groups within the quantity ordered but quantities in any *one* group cannot be assured. Coding should be specified only when definite advantages justify the additional cost.

DESIGNERS HANDBOOK *FREE* TO ENGINEERS

If you work with miniature bearings, you'll find this new, 70 page authoritative publication a great help in solving problems in designing instruments or small electro - mechanical assemblies.

Free to engineers, draftsmen and purchasing agents.

Write New Hampshire Ball Bearings, Inc., Peterborough 1, N.H.



RESEARCH WELDING

for fabrication beyond the standard concept

For fabrication of guided missile components and atomic structures and for other technical projects, Research Welding is equipped to process experimental work requiring high-strength or corrosion-resistant alloys.

Our facilities include a 650-ton capacity HPM metal forming hydro press and the latest automated welding equipment. Mass Spectrometer and hydro testing; USAF-approved quality control procedures.

Research Welding has developed components for CalTech, Douglas, DuPont, Firestone, GE, Hughes, Bell, Northrop, USAF.

Let us analyze your problem. Call or write today for information. New, ultra-modern plant now under construction will provide even greater facilities for the scientific development of your special projects.

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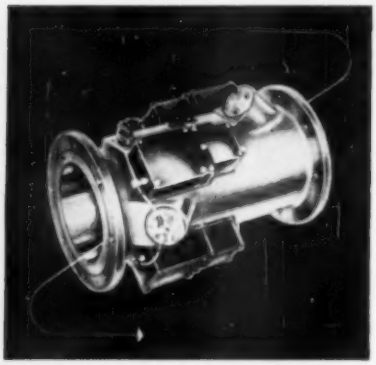
WELDING & ENGINEERING CO., INC.

10608 SANTA FE AVE. • SOUTH GATE, CALIFORNIA

NEW AVIATION PRODUCTS

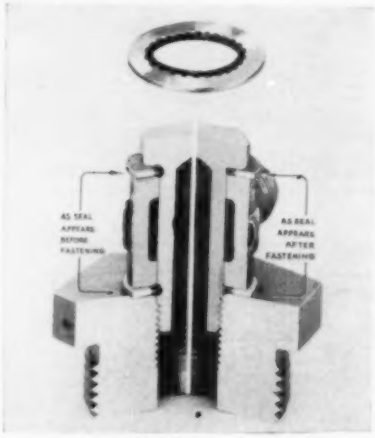


Flowmeter Uses Ultrasonics

Ultrasonic energy is utilized to determine volume or mass of fuel passing through a smooth-bore sensor. Simultaneous readout of mass flow rate, mass totalization, volumetric flow rate, volumetric totalization and fluid density can be obtained. The device will handle up to 720,000 lb. or 90,000 gph. of jet fuel with an accuracy of 1%.

The sensor for a four-inch line is 10 in. long and weighs 10 lb.

Maxson Instruments Division, The W. L. Maxson Corp., 4737 Austeel Pl., Long Island City 1, N. Y.



Seal and Retainer

Zero leakage of banjo fittings is assured by rubber seal and metal retainer. It eliminates disadvantages of crush washers, provides metal to metal contact of faying surfaces and is free of seal loss due to cold flow, reverses or surges. The seal works with pressures beyond 5,000 psi against air, oil or fuel and at temperatures from −65°F. to 350°F. The seal will withstand intermittent temperatures to 500°F.

Franklin C. Wolfe Company, Inc., 10567 Jefferson Blvd., Culver City, Calif.

Drive Test Stand

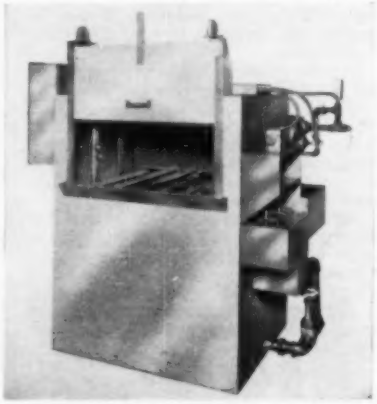
Constant speed drive test stand uses electronically controlled variable speed motor to simulate variations of engine speed in flight and measures any deviation of constant speed drive from the established value. Tests in the operating range from 200 to 8500 rpm. Optional accessories are: ventilating blower

for generator and alternator, load bank for alternator and generator, frequency meter to test drive stability and jib crane to mount specimen drive units weighing up to 500 lb.

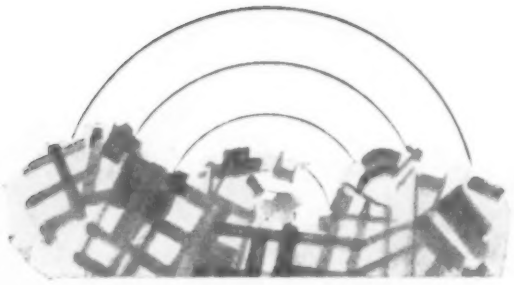
Greer Hydraulics, Inc., New York International Airport, Jamaica 30, N. Y.

Automatic Cleaner

Small parts are cleaned, rinsed and dried by an automatic machine which can process 40 baskets per hour. Automatic adjustable cleaning sequence



uses hot recirculated cleaning solution spray, hot water rinse spray and drain dry. Hot air drier may be added if required but latent heat of parts is expected to make drain drying adequate. Chips and foreign material are removed from washing solution by chip basket. Solution tank forms the base of the



...and the U.S. Navy's Offshore Patrol that guards America

While you work, while you play, while you sleep—though any threat to your way of life be the farthest thing from your mind—the U. S. Navy is in action in the air along America's shores, protecting the peace you enjoy. This particular phase of Naval Aviation is the job of the Navy's "Offshore Patrol". . . and Curtiss-Wright power is everywhere in the picture.

Curtiss-Wright Turbo Compound® powered Lockheed Super Constellation WV early warning radar planes, and Lockheed Neptune P2V and Martin Marlin P5M long-range reconnaissance planes cruise far out to sea—day and night, ever watchful. Cyclone 9-powered Grumman Tracker S-2F sub hunters and Sikorsky HSS helicopters range closer in, providing a tight defense ring against invasion. Cyclone 7s power Vertol HUP helicopters, and Goodyear CPG blimps with Curtiss Electric Propellers. The resultant "protection perimeter" extends from the Arctic Ocean south around the entire continent.

These Curtiss-Wright aircraft engines—plus Curtiss-Wright jet and rocket power—are ready if anything disturbs the peace. Meanwhile, they help you to work and play in confidence, sleep soundly.

YOUNG MEN! BECOME A NAVAL AVIATOR

Apply at any Naval Air or Recruiting Station

WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT
CORPORATION • WOOD-RIDGE, N. J.

World's Finest Aircraft Engines

Which one will qualify as a missile engineer?

All—or none—depending on three important points! The desire for a *real* engineering challenge. The ability to work with a top team of experts in their respective fields. The capacity to take on individual responsibility.

If this sounds like a lot, it's because North American Aviation has a lot to offer. With research, development and manufacturing responsibility for the U. S. Air Force SM-64 Navaho Intercontinental Missile, the scope of the art at North American is wide and the opportunity to assume a position of authority great. In fact, all phases of this project—research, design, development and testing—are being accomplished by North American engineers.

And what benefits will you find in this type of engineering environment?

First of all—recognition that comes from the opportunity for individual effort. You will work with engineers who respect your opinions and professional status. Because missile engineering covers so many fields, you can work in the area of your choice. You will work on a team of specialists whose leadership in their fields will further you in the one you choose. You will live in Southern California and receive financial compensation limited only by your own ability.

If you have the desire for a real engineering challenge—Investigate Now.

Contact: Mr. M. Brunetti, Missile Engineering Personnel
Dept. 56-9 AW, 12214 Lakewood Boulevard, Downey, Calif.

NORTH AMERICAN AVIATION, INC.

cabinet and contains plate coils for heating of cleaning solution.

Ransohoff Inc., 1001 Ford Blvd., Hamilton, Ohio.

Hydraulic Valve for 1,500 Psi.

Hydraulic valve for aviation use weighs about one-third pound and is designed for 1,500 psi. working pressure. It features a molded rubber valve seat permitting hydraulic pressure of the system to be pumped up while the valve is closed.

Applications of the Model 4500 include parking brake and helicopter rotor brake systems in addition to pneumatic pressure controls. Unit meets MIL-O-5606.

Scott Aviation Corp., Lancaster, N. Y.

ALSO ON THE MARKET

Model 348 Linear Amplifier meets all requirements for amplifying adjacent low and high level pulses at high duty cycles from scintillation detectors, ionization chambers, and other radiation detectors. Measurements may be made of kev Cs^{137} X-Ray peak in the presence of a 1,200,000 c/min Co^{60} (1.13, 1.33 mev.) background.—Franklin Electronics, Inc., East Fourth St., Bridgeport, Pa.

Heat reflective laminate, by combining principles of reflectivity of radiant energy with insulation characteristics of glass fabric reinforced plastic, affords a barrier to heat transfer at temperatures up to 1,200F. Additional advantages are weight savings and adaptability to molded designs.—Swedlow Plastics Co., 6986 Bandini Blvd., Los Angeles, Calif.

Inchworm motor, a linear actuator, is accurately controllable in the range of micro-inches. Employing magnetostrictive effect, armature of the motor shrinks under influence of an electromagnetic field, snapping back to original size when magnetic field is de-energized.—Airborne Instruments Laboratory, Inc., 160 Old Country Rd., Mineola, N. Y.

Patented **Nylok self-locking insert,** a nylon pellet installed in threaded portion of a screw, is now an optional feature of SPS standard, special and aircraft socket screw products. Insert eliminates need for other locking devices.—Standard Pressed Steel Co., Jenkintown, Pa.

Grade G-10-865, glass-base sheet laminate bonded with an epoxy resin, has low water absorption, low dissipation factor, and high bond strength; it meets MIL-P-18177. Material is available in sheet sizes of 39x47 in. with thicknesses from $\frac{1}{32}$ to $\frac{1}{4}$ in., and can be supplied as a standard laminate or with copper foil on one or both sides for printed circuits.—National Vulcanized Fibre Co., 1056 Beech St., Wilmington, Del.

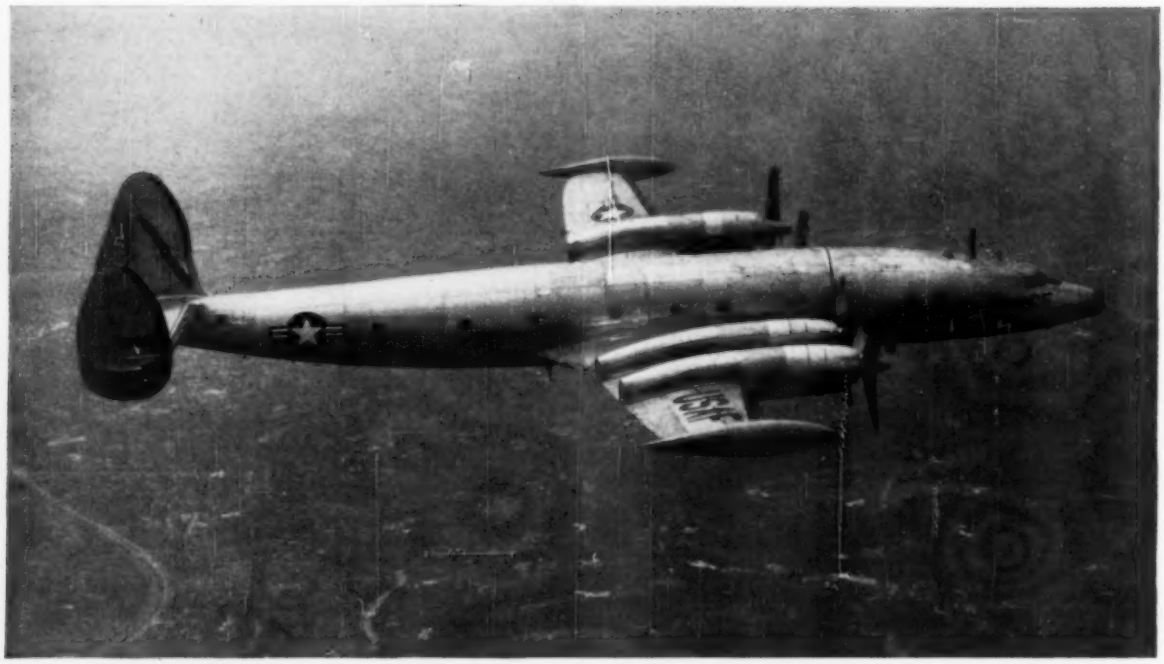
Filmsort semi-automatic optical mounter combines two microfilm processing operations in one; makes large-screen ($12\frac{7}{8}$ in. x $14\frac{1}{2}$ in.) visual checks of filmed material during actual card mounting steps. Unit is designed for use with all types of cards in which film apertures correspond to general U.S. Military specifications.—Filmsort Division of Dexter Folder Co., 50 South Pearl St., Pearl River, N. Y.

Model LA09 10-turn, $\frac{7}{8}$ in. diameter precision potentiometer has all-metal external construction, metal-to-metal stops, stainless steel ball bearings, and glass-sealed terminals.—Litton Industries, Components Division, 5873 Rodeo Rd., Los Angeles 16, Calif.

Model DV-1, power supply and demodulator unit, has been developed for use with gyros in flight test applications where 115 v. 400 cycle single-phase primary power is available. Unit is $6\frac{1}{16}$ in. wide x $7\frac{3}{16}$ in. high x $12\frac{3}{4}$ in. long; it weighs 13 lb.—Doelcam, a Division of Minneapolis-Honeywell, 1400 Soldiers Field Rd., Boston, Mass.

ACCURACY!
Each month, hundreds of Whittaker gyros are used in the missiles which are so vital to our nation's defense. Accuracy in this project is of critical importance. Whittaker gyros meet these requirements with a rejection rate of less than 2%. Whittaker Gyro will be pleased to place its experience and facilities at your disposal.
Whittaker Gyro
DIVISION OF TELECOMPUTING CORPORATION
VAN NUYS, CALIFORNIA
STANLEY 7-5511

Turboprop transports with set records on



THE LOCKHEED YC-121F, powered by four Pratt & Whitney T-34 turboprop engines, is the world's fastest propeller-driven transport. The aircraft cruises at 420 mph.

A PRATT & WHITNEY AIRCRAFT T-34 turboprop engine is loaded aboard a YC-97J Boeing Transport.

MATS COMMANDER Lt. General Joseph Smith cites the engine's record: "My Continental Division reports that these power plants require considerably less maintenance than that required for any of our larger transport engines in common use. This remarkable record forecasts the fine service we can expect from the Douglas C-133A transports which will soon be in MATS operation." Pratt & Whitney Aircraft is most grateful for the magnificent accomplishments of MATS which are contributing very substantially to the success of the T-34.

PRATT & WHITNEY AIRCRAFT
DEPENDABLE ENGINES

T-34 engines MATS World Routes

6000-horsepower T-34s show their stamina in Boeing and Lockheed transports

The Military Air Transport Service is already using Pratt & Whitney Aircraft T-34 engines in Boeing YC-97Js and Lockheed YC-121Fs on its world routes. This engine also powers the Douglas C-133A, the highest payload production transport ever to go into service.

The outstanding service performance of the T-34 engine is another example of Pratt & Whitney Aircraft's continuing leadership in design, development and production of dependable engines.

New records include—

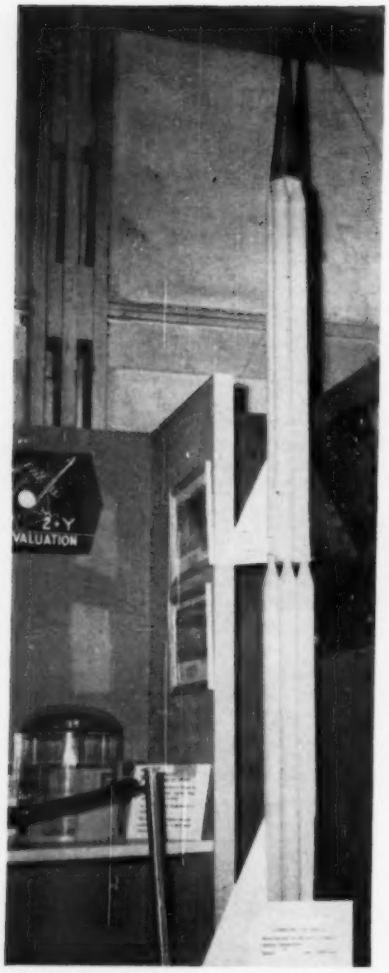
- A Lockheed YC-121F flight from over Gander, Newfoundland, to abeam of Shannon, Ireland, in 4 hours and 13 minutes.
- Boeing YC-97J round trips from Texas to Germany and Japan, the first turboprop transport flights across both Atlantic and Pacific.
- A new in-service MATS record, set when two YC-97Js flew a total of 46 hours and 35 minutes during a single 24-hour period.

EACH BOEING YC-97J has accumulated over 1000 flight hours and their engines are already operating over 500 hours between overhauls. These aircraft have maintained 6.1 hours daily utilization during a single month, demonstrating the reliability of the airframe, propeller, engine combination.

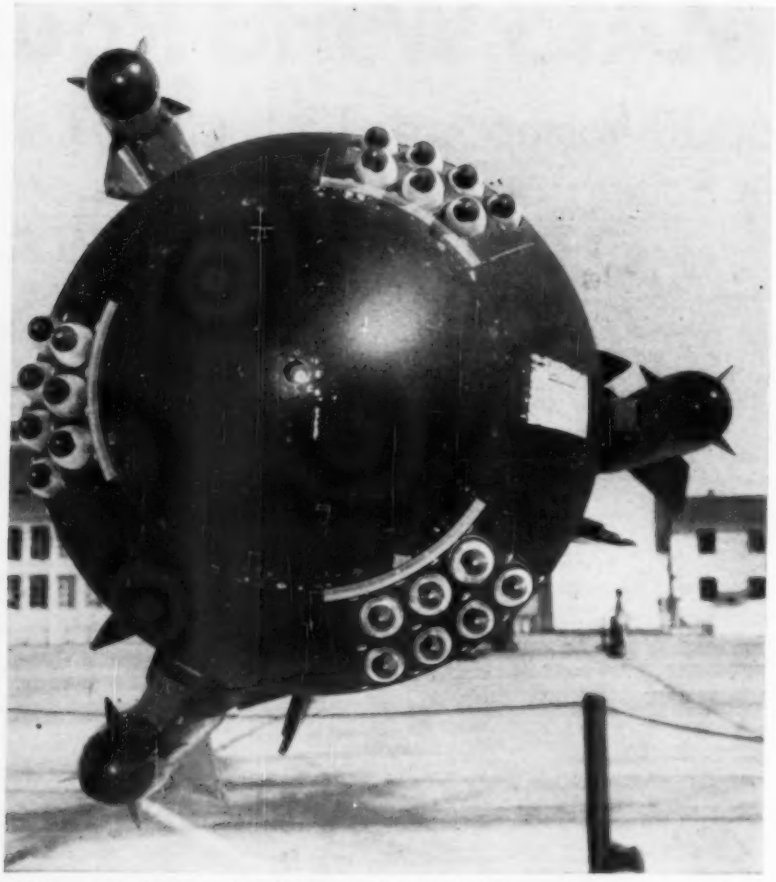
PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation • Main Office and Plant: East Hartford, Connecticut
Branch Plants: North Haven—Southington—Meriden

National Aircraft Show Displays



AEROPHYSICS hypersonic test vehicle.



F-89H wingtip pod carries three Falcon missiles and 21 2.75 in. rockets.

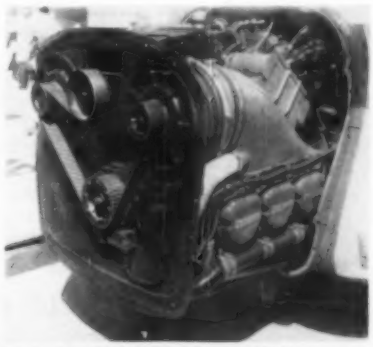
TEMCO Model 51 primary trainer experimental airplane was shown at Oklahoma City. Navy has ordered evaluation quantity.

PILOTS demonstrate roominess of Cessna T-37 cockpit.

WHEN T-37 thrust attenuator (above) opens . . .

JET INTAKE screen retracts flush with fuselage when gear is up. Stall warner on top operates automatically to accent buffeting.

. . . **IT DIVERTS** jet blast sidewards, kills 40-60% of thrust. Control quadrant micro switch opens plates below 78% of power.



FORWARD position of Continental FSO-470A engine (top right) eliminates special induction, lubrication systems in Cessna YH-41 helicopter. Rotor has simple pylon mount (bottom).

Around the equator 1,500,000 times!

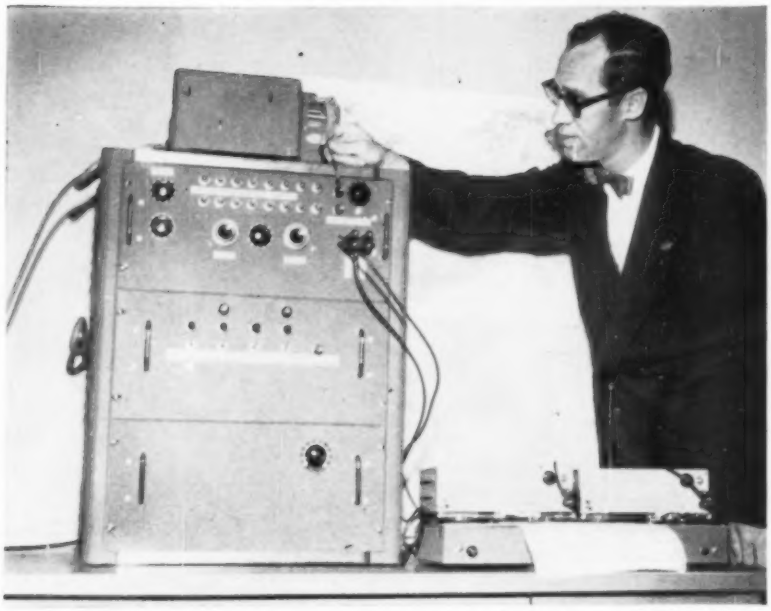
Passengers on the scheduled air fleets of the world last year logged 38 billion miles—enough for one passenger to fly around the equator a million and a half times! This figure represents a gain of 18% over total passenger miles flown in 1954. And this amazing record is expected to be broken again in 1956.

As more and more people fly more and more miles, new and better planes are being developed to serve them. To keep these planes flying, operators know they can rely on Esso Marketers for the finest in modern aviation fuels and lubricants—perfected through years of research—and for the finest in uniform, safe and efficient petroleum service along the airways of the world.

8 OUT OF 10 OF ALL THE WORLD'S INTERNATIONAL AIRLINES USE

ESSO

AVIATION PRODUCTS



HYCON COMPUTER (left) is used to process geophysical data rapidly and present finished aeromagnetic maps without long delays. A plane in one hour often records enough data to keep the Hycon office busy for about 100 hr. Photo crew (right) of AT-11, World War II Air Force bombardier and navigator trainer, prepares for photo mission with Hycon-developed camera and map study. Hycon is pioneering development of aerial color photography with its own temperature control, developing methods.

Aerial Surveys Grow on Speed, Savings

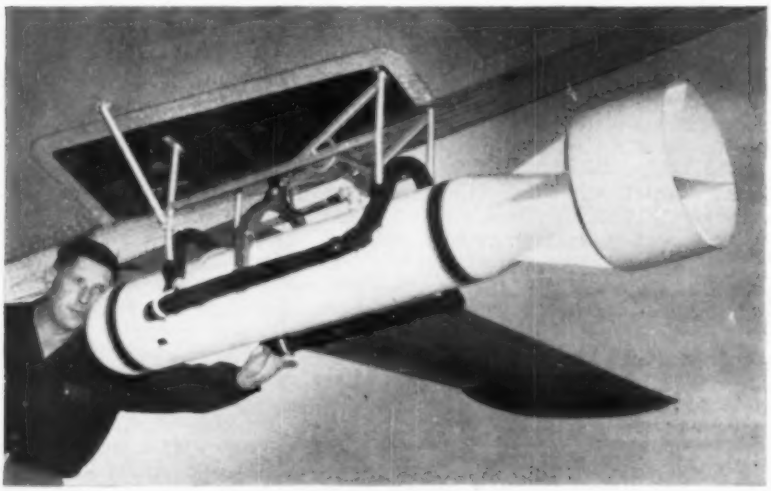
By Bernie Lang

Pasadena, Calif.—Mining, oil, lumber and other firms needing quick and accurate mapping and exploratory services are boosting the aerial survey industry to levels of $18 million a year. One of the top firms is Hycon Aerial Surveys, Inc., jointly owned by two companies which develop much of the equipment it uses. Varion Associates of Palo Alto, Calif., provides many of the electronic devices and Hycon Mfg. Co., through its camera and instrument division, pioneers much of the photo equipment.

Although headquartered in Pasadena, Hycon Aerial also maintains laboratory facilities and offices in Washington, D. C.; Dayton, Ohio, and Florence, Italy, and sales offices in Santiago, Chile; Lima, Peru, and Quito, Ecuador.

Proved economy, both in time and money, is the big reason for aerial survey popularity. Hycon points out that on one contract alone, two and one-half years and $80,000 were saved on a project to determine whether a road would go around or through a mountain.

If solved by ground survey methods, it would take approximately three years and cost about $100,000; by air it required six months and only $19,932.



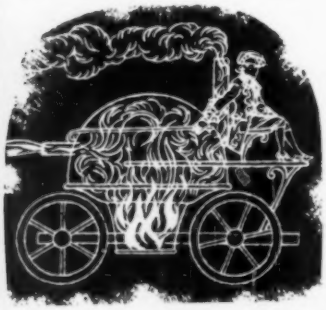
BIRD USED to detect ore deposits. Bird contains two sensitive coils each tuned to one of the transmitted frequencies, making it possible to test a 400-ft. swath beneath the plane.

Techniques Offered

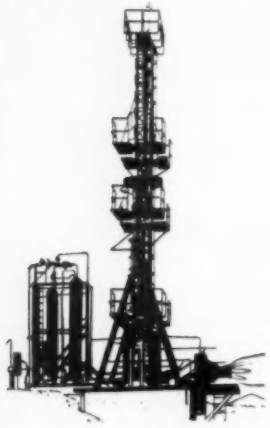
Services and techniques offered by the company include photogrammetric engineering; photographic and geophysical aerial surveys; photo-geologic evaluation, and planimetric mosaic, and topographic maps.

Demand for aerial surveys is worldwide and Hycon is equipped to handle both domestic and foreign expeditions in such fields as geology, forestry, soil conservation, petroleum, mining, highways, railroads, traffic, utilities, pipe lines, transmission lines, taxation, harbors, flood control, city planning, legal evidence, water resources and wild life inventory. Soon to be introduced are

LIQUID ENGINE DIVISION



In piloted aircraft, missiles, and upper-atmosphere research vehicles, Aerojet-General liquid-propellant rockets have proven unexcelled for assisted takeoff, superperformance, and as prime power-plants.



Whether your interest lies in Vanguard or valves, Aerojet-General offers a variety of challenging assignments for:

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Electronic Engineers
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Electrical Engineers
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Write: Director of Scientific and Engineering Personnel, Box 296N, Azusa, Calif. or Box 1947 Sacramento, Calif.

PBY WHICH SERVES as Hycon flying geophysical laboratory showing horizontal loop which transmits an electromagnetic field. Bomblike structure (aft, below) is detector or "bird" which picks up signal indicating position of ore deposits. Plane also carries 35 mm. spotting camera to record flight path.

aerial surveys by helicopter, furthering Hycon's already wide potential.

Underway is a test program using a Bell 47G-2 equipped with magnetometer, electromagnetometer and scintillometer preparatory to starting domestic contract work early this fall.

"Geophysical exploration can be done ten times as cheaply and infinitely more rapidly from a helicopter than from ground surveys," said Hycon's Geophysicist Ken Hunter. Since some of the largest mines are located on tiny plots of land of only 200 acres in the roughest terrain, the company's helicopter system will enable detailed surveys to be made over areas too small to be economically feasible for fixed-wing exploration.

Aircraft Requirements

Aircraft requirements vary with the diversified fields of surveys. World War II surplus planes, complemented with current Cessna and Beechcraft models, are in use.

They are selected for their operational qualities. A P-38, for instance, is suitable for certain types of mapping of high terrain requiring altitudes up to 36,000 ft. At present, Hycon's fleet consists of 12 planes: four Cessna 195s; one Beechcraft AT-11, one Beechcraft Bonanza; one PBY and five P-38s.

With an eye to the future Hycon is:

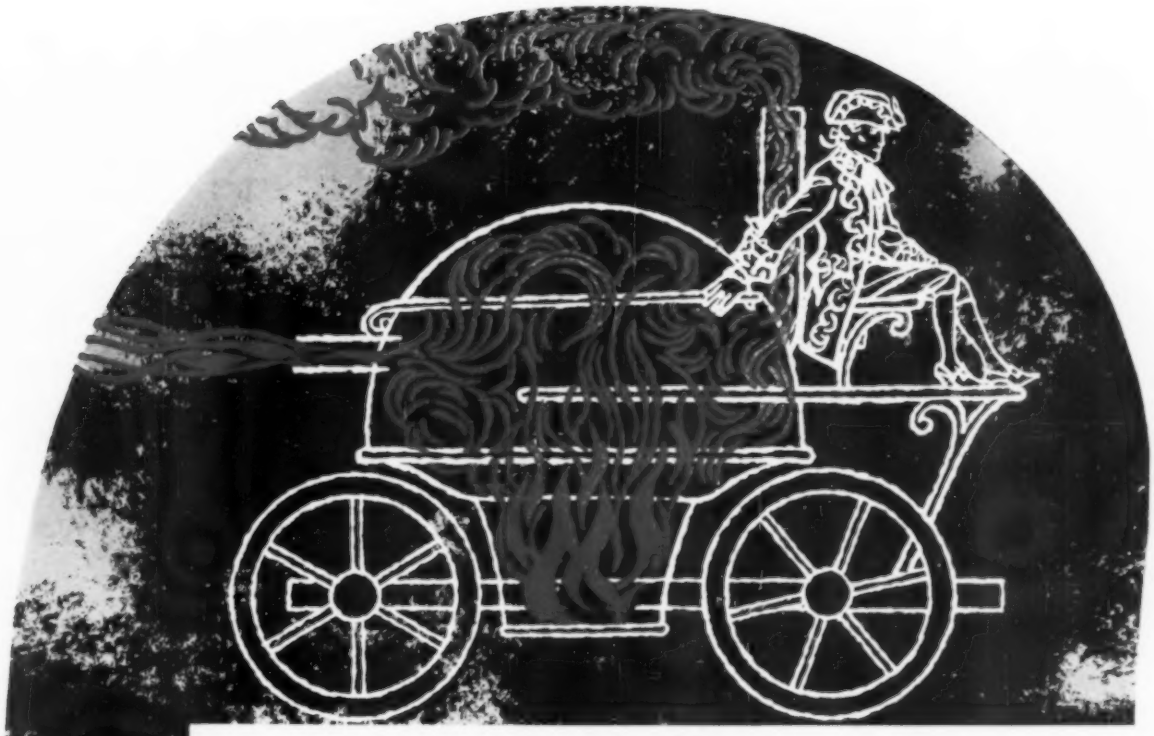
- **Introducing helicopter** aerial surveys carrying three detection devices on a single flight.
- **Developing aerial** color photography techniques for spotting mineral deposits and for forestry evaluation.
- **Using a light-weight** image motion-compensation camera which permits aerial photography from a small, single-engine plane. This, for the first time, makes low altitude photographs that are not blurred.

Three electronic devices which have contributed so much to aerial surveys are the magnetometer, electromagnetometer and scintillometer.

Magnetometer searches out large mineral deposits by recording the deviations they produce in the earth's magnetic field. It has been used to locate ores of iron, copper, lead and zinc. It aids geologists find structures which may contain oil. The helicopter version of the magnetometer, through careful engineering, will weigh only 80 lb.

Electromagnetometer pinpoints the mineral deposits which are electrical conductors. It is sensitive enough to detect sulfide ore bodies that contain copper, lead and nickel. The device sets up a large magnetic field by sending an electric current through a wire coil built around the plane, then measures the distortions induced in this field by electrical conductors in the earth.

Towing a bird (electromagnetometer) containing two sensitive coils each tuned to one of the transmitted frequencies makes it possible to test a 400-ft. swath beneath the aircraft. Helicopter version will measure both in-phase and out-of-phase components of the field at a frequency of 4,000 cycles. The helicopter unit has completed 2,000 line mi. of test flying over known ore bodies in Canada with excellent results, according to Hycon. Developed by Aeromagnetic Surveys,



s'Gravesande's Stoomwagen

s'Gravesande's Steam Reaction Car

In 1721 Jacob Willem s'Gravesande of Delft, stimulated by the recently enunciated Third Law of Motion, astounded the Royal Society by constructing a practical steam reaction car. The vehicle actually moved several times its own length, a distance of about two meters.

In 1956 the goal is no longer meters, but hundreds, and even thousands, of miles. Aerojet-General Corporation, leader in American rocket propulsion for more than a decade, is proud to participate in man's first assault on the frontiers of outer space—Project Vanguard.

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Argentine Home-Built Lightplane

Misionero I, which is a replica of the French Jodel monoplane, was built at home in 100 days by an Argentine farmer, Arnold Berkling, and his wife. The two passenger airplane is powered by 65 hp. Continental engine. Berklings, who live in Northern province of Misiones (thus the airplane name), find airplane most logical means of travel in remote area, turned to home-building because of high cost of private plane in Argentina.

Ltd. of Toronto, Canada, the bird is made of doped cloth and Fiberglas. Hycon is the sole U. S. licensee.

Scintillometer determines radioactivity levels. The multiple channel scintillation counter provides, after suitable data reduction, precise information on total field gamma radiation, information on the spectrum of the radiation, positive identification of the terrain at all times, and a positive record of the elevation of the aircraft above terrain. All records are correlated with photographs taken by a 35 mm. camera as the aircraft flies on flight lines determined on a previously prepared photomosaic. A synchronized recording radio altimeter provides a continuous record of flight altitude. With these records, precision contour maps, accurately positioned on a photomosaic can be made.

Color Pioneering

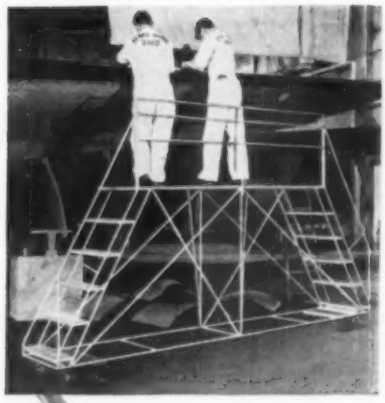
Hycon is pioneering the development of color photography and to date has over 100,000 sq. mi. of successful results. With careful temperature control, purity of developing solutions and other developments in camera methods, this new step in natural resources evaluation gives oil companies vital information on subtle variations in the rock color. Mining companies find spotting the vivid blues and green colors of copper deposits and the vivid canary yellow of the various carnotite members of the uranium family very useful.

"Timber cruising" with the aerial camera is another Hycon service. Infrared photography distinguishes hard wood from soft wood growth. When color photography is coupled with stereo plotting map making technique, controlled geologic maps can be turned out without a geologist setting foot on the ground.

Oil, Mining

This accounts for a large portion of the aerial survey business because oil and mining companies now are willing to spend money to get a preliminary evaluation study before they spend staggering sums for actual detailed ground geophysical and drilling programs. The modern executive in exploration adopts the "lets give it a bird's eye look" with modern geophysical and photogrammetric technique before embarking on a full program.

Another one of Hycon's services is its flying geophysical laboratory, a PBY amphibian carrying well over a ton of highly sensitive electronic instruments which make mineral resources surveys of very large areas in a matter of months. The flying laboratory can cover 100 sq. mi. a day, an area that would take a year to cover on the ground using the older prospecting methods. U. S. oil and mining companies as well as private and federal



airplane maintenance time cut 20% with BALLYMORE WORK PLATFORMS

At Atlantic Aviation Service, New Castle, Delaware, they find that by using Ballymore Work Platforms for reaching high levels on larger planes they save money and cut maintenance time 20%. The platforms are simple to mount and provide easy movement around the engine or other parts of the plane being repaired. And mechanics can take all their tools with them to eliminate running up and down.

Atlantic Aviation Service uses several types of Ballymore work platforms, either singly or grouped together so that a number of service men can work at the same time. They find them particularly effective for engine repairs, painting, putting de-icer boots on wings and similar jobs.

All welded steel construction, the platforms roll easily into position on smooth-running, ball-bearing casters and lock firmly to floor by a treadle system. No sway or "kick-out". Handrails and guards help prevent falling, safety grids on steps and platform help ward off slipping. Write today for more information to Ballymore, Company, Wayne 21, Pennsylvania.

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Sprints from deck to stratosphere

His beat is the oceans of the world. His job, to challenge unknown intruders on our defense perimeters. A Navy pilot is a seagoing sentry on 24-hour duty.

A major role in this job of positive interception—and as far from our shores as possible—is being assigned to the Douglas F4D Skyray. Less than a minute after leaving the deck, Skyray can soar past the 10,000-ft. mark. Seconds later it's hissing through the stratosphere . . . 35,000 feet up . . . at the ready with rockets and cannons.

This rate of climb comes as no surprise. Skyray also holds the world's official F.A.I. sea level speed records for the 3- and 100-kilometre courses.

Douglas F4D Skyray—fastest carrier-based interceptor. Performance of agile Skyray continues the Douglas tradition of "faster and farther with a bigger payload." Yet performance figures are meaningless without a skilled pilot at the controls. If you are interested in a career as a Naval Aviator, write Nav. Cad. Washington 25, D. C.

Depend on *DOUGLAS* **First in Aviation**

Bell Ranger Makes Sales Tour in South America

At least 17 major sales demonstrations in 15 Central and South American countries are planned for new four-place Bell 47J Ranger utility helicopter. Piloted by Joe Mashman, assistant director of contracts, the Ranger left Bell's Ft. Worth, Tex., Helicopter Division at maximum gross weight of 2,565 lb., including conversion kits that quickly adapt the aircraft for specialized missions and extra fuel. Cabin has a plush interior, pointing up its executive transport role. The Ranger demonstrator is expected to return to the factory in November.

agencies of foreign governments are offered the plane at a cost of about $100 per sq. mi.

Hycon's current sales backlog of over $1,185,000 includes projects for the U. S. Army Map Service, Republic of Haiti, California State Division of Highways and major oil and mining companies in South America, the Caribbean and Alaska.

Germans Will Open Private Air School

Bonn—First and only private aviation school in Germany will open in Frankfort Oct. 1 under the name Luftfahrtschule Avias—Privatfachschule Fuer die Zivile Luftfahrt. The school will train personnel for all branches of civil aviation.

As a result of the shortage of trained aviation personnel, the civil airlines have promised full assistance to the school. Training personnel will consist exclusively of former and present civil aviation experts. Airlines will make available personnel and facilities for the practical part of the training.

Miami Firm Converts Three Cessna T50s

Miami—Air Corporation of Miami has completed the conversion of three Cessna T50 aircraft for a Chilean carrier.

Seating capacity of the twin-engined planes was boosted from five to seven and a lounge installed. Removal of the snap-on passenger seats makes possible the quick conversion of the Cessnas to freight carriers.

Replacement of the aircraft's 225 hp. Jacobs engines with 300-hp. Lycomings has improved their short-field capabilities, according to Air Corporation. The firm has performed previous conversions of the same airplane for various users.

Piper Sales Jump

Business and utility plane sales are up 126% over a year ago, Piper Aircraft Corp., Lock Haven, Pa., reports. Compared with two years ago the increase is 184%. Increase in fiscal 1956 (Oct. 1, 1955 through August, 1956) by models; Super Cub PA-18 and PA-18A, 125%; Tri-Pacer PA-22, 124%, and Apache PA-23, 136%.

PRIVATE LINES

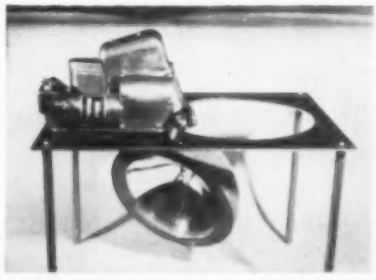
Nylon-cord tires for lightplanes at the same cost as rayon-cord equipment are being offered by Firestone Tire & Rubber Co., Akron, Ohio. The new tires replace the firm's rayon-cord line. Initial available sizes are: 7.00 x 6 with four-ply rating and eight-ply 11.00 x 12; eight additional sizes will be placed on the market soon.

Award for outstanding contribution to agricultural aviation in 1956 was presented to C. J. (Jack) Reese, Continental Motors Corp., president, by National Association of Flying Farmers at their national convention.

Sikorsky S-58B, recently delivered to Okanagan Helicopters, Ltd., will supplement the firm's five S-55s in cargo carrying operations to defense installations in northwestern Canada.

Two Cessna 182s have been equipped with the new Federal autopilot by Pacific Airmotive Corp. to demonstrate the equipment to fixed base operators and aircraft dealers in a 15-state area in the West and Middle West. The tubeless autopilot sells for $1,995 in the single-axis version and about $2,300 for the two-axis model (AW Apr. 23, p. 105).

Helicopter is used by a Detroit, Mich., real estate organization to give prospective home-owners an aerial view of its new housing development.



ROTABLE LIGHT can be used for landing and taxi illumination, having a 360-deg. rotation in either direction and about 120-deg. extend-retract arc. Eight-point switch permits control of illumination like a spotlight. Lamp is 450 watts. Maker of light, Grimes Manufacturing Co., Urbana, Ohio, uses the G-6250-3 light on its Beech D18S and Cessna 310 business planes.

AVIATION WEEK

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British Court of Inquiry Report:

Crash Crews Avert Fire in York Crash

On the morning of April 30, 1956, a York aircraft G-AMUL (usually called "Uncle Love") was due to take off from Stansted Airport in Essex on a flight via Malta to Habbaniyah in Iraq. The aircraft was owned and operated by Scottish Airlines (Prestwick) Ltd. and the flight was being made on charter by the Air Ministry to carry Royal Air Force personnel and members of their families. The passengers numbered 45 of whom 14 were children between the ages of 2 and 10; in addition there were four babies. The aircraft carried a crew of five and fuel sufficient for the flight.

Shortly after 0930 GMT in perfect weather conditions "Uncle Love" started on its take-off run piloted by Capt. W. L. Wilson with the assistance of First Officer Upperton. After traveling 300 yd. along the temporary runway then in use at Stansted Airport the aircraft developed a swing to starboard with a consequential skidding movement of the tires so severe that within a further distance of less than 100 yd. it left the runway on the starboard side still under the influence of the swing, skidding and travelling at about 45 kt.

On reaching a French drain 25 ft. from the runway, the lateral stresses put upon the undercarriage were such that it collapsed, the starboard wheel falling clear, and the aircraft settled on its belly and on the port wheel, which was forced up into the fuselage. The aircraft traveled a few yards farther, still swinging to starboard, and finally came to rest pointing back almost in the direction from which it had begun its run.

Two Killed

The effect of the entry into the fuselage of the port wheel was to force up and distort the seats immediately adjacent to the point of entry, killing an aircraftman and a 4-year-old girl, and inflicting serious injury to four other passengers. Due to the belly of the fuselage as it settled being forced to starboard, it met the starboard inner propeller, which cut the control lines to the fuel cocks. It was impossible to prevent the escape of 700 gal. of petrol, a large quantity of which poured into the passenger cabin and onto those who were pinned by the entry of the port wheel.

It will be realized from the circumstances described that the danger of fire was acute. Mercifully the Airport Fire Brigade was at the scene literally within a few seconds of the aircraft coming to rest and it laid a blanket of foam over-all so that the risk of fire was averted. The crew and the uninjured passengers meanwhile left the aircraft and the various obstructions were then cut away to permit liffing with cranes, making it possible to release those injured.

In order to examine the causes and circumstances of this accident and to answer the questions put by the Attorney-General in the course of the public inquiry, it is necessary to consider firstly the airport and in particular the construction both of the runway and the French drain on meeting which the undercarriage collapsed.

Secondly I proceed to consider the suitability of the aircraft and whether the accident is attributable to any mechanical failure, and thirdly the handling of the aircraft by Captain Wilson. After discussing these three subjects and giving my answers to the questions asked I have thought it desirable to deal with a complaint made by a passenger in regard to the safety belts provided in the aircraft and to describe with some further detail the action taken after the aircraft came to rest both to avert fire and to free the injured. Finally I desire to make a recommendation with regard to the French drain.

STANSTED AIRPORT

• Runway

Stansted Airport is the property of the Ministry of Transport & Civil Aviation and is used as a base by several charter companies including Scottish Airlines (Prestwick) Ltd. and also by the U. S. Air Force. Main runway of the airport lies from 050 deg. to 230 deg. magnetic and was formerly 140 ft. wide and 6000 ft. in length but is at present being reconstructed. Since July 1, 1955, while the work of reconstruction has been proceeding, all aircraft using the airport have used a temporary runway parallel to and 650 ft. to the northwest of the main runway. The word temporary as applied to this runway is likely to prove misleading since it is not by any means a make-shift affair. It is 5,700 ft. long and is composed of the former taxiway of that length with the addition of a strip (called a shoulder) on either side to provide the extra width required for a runway.

The former taxi-way was 90 ft. wide with a good macadam surface and capable of sustaining the weight of any aircraft. To this has been added on each side a strip or shoulder 25 ft. wide constructed of a layer of Class C Fill (a kind of compacted gravel) with broken concrete in some places in addition, the whole being covered with two inches of close macadam to form the same surface as that of the former taxiway. Although not so strong as the taxiway, the shoulders are of sufficient strength to support occasional use by aircraft.

Width of the runway formed by the old taxiway and the two shoulders is thus 140 ft., being the same as that of the main runway before reconstruction. In practice, however, this overall width is to some extent reduced by American type electric lights standing 19 in. high and fixed to the runway by spikes at intervals along either side and connected by rubber tubing.

These lights are fixed at a distance of 10 ft. in from the outer edge of each shoulder so that the width of the runway between the lights is 120 ft. A broken white line marks the center of the runway throughout its length and there is also a continuous white line painted on either side at the junction of the old taxiway and the shoulders.

This runway is undoubtedly narrow for an aircraft of the size of a York, which has a wing span of 102 ft. and a wheel base of just under 24 ft. A pilot taking off a York from this runway would naturally seek to avoid letting his wheels go onto a shoulder although, if he did, it would support the weight as it supported that of "Uncle Love" on the morning in question. If he hit any of the lamps it would be most unlikely to cause the aircraft the slightest damage.

Although admittedly narrow for an aircraft of this size, there is no doubt that this temporary runway is serviceable. It has in fact been used consistently by York and other aircraft of comparable size since July 1, 1955, and I am satisfied that with proper skill and care no experienced pilot should have found difficulty in taking a York aircraft into the air from this runway in the perfect weather conditions experienced on the morning of the accident.

Capt. Wilson himself had taken off York aircraft from this runway without difficulty on at least 10-12 previous occasions and stated in the course of his evidence, when asked whether he was at all troubled on this occasion by the width of the runway, that he was "not conscious of any undue narrowness."

• French drain

On the south side of the temporary runway and 25 ft. out from the outer edge of the shoulder is a drain of the type called a French drain laid parallel to the runway throughout its length. I am satisfied on a body of evidence which was undisputed that it was after the aircraft had left the runway (still swinging to starboard and with its wheels skidding to port) and when it met the obstacle formed by this drain that the undercarriage collapsed. Had it not met the drain it is possible that "Uncle Love" would have continued its spin on the grass until ultimately it came to rest as a result of the loss of momentum. In that event the passengers would have escaped with no more than a severe shaking and the aircraft would not have sustained major damage. The siting and construction of this drain accordingly requires examination.

This drain, which has its counter-part on the north side of the runway, was constructed at the same time as the shoulders. It consists of a trench 3½ ft. deep along the

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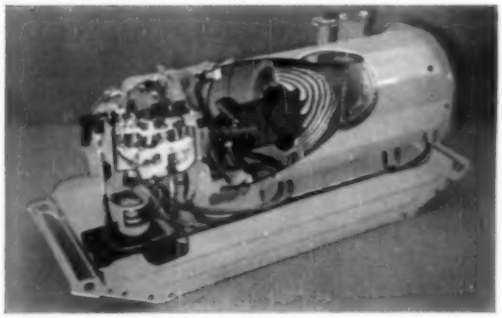

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bottom of which a porous cement pipe has been laid on a concrete bed. The trench above the pipe was then filled with what are termed rejects—stones and pieces of concrete—which would not pass through screens used to select the Class C fill—and pieces of concrete employed to form the base of the shoulders.

Any attempt to ram or roll this filling might result in breaking the pipe and in consequence it was necessary either to leave the filling some inches "proud" to allow for settlement or to top up from time to time as settlement occurred. In fact, the filling was left "proud" and now that a year has elapsed since the work was done it is in many places at least 6 in. "proud" and the stones at the top are large and indeed, to borrow the term employed by H. M. Solicitor General, could in some cases be described as small boulders.

The drain follows a line formed at the point where the grass, sloping down from the outer edge of the shoulder, makes a dip with the slightly rising ground further to the south. It is accordingly sited at a point where drainage is obviously necessary both for the ground south of the runway and in order to take away surface water from the runway itself and water which might otherwise accumulate below the shoulder.

I was told and I accept that this type of drain accords with standard practice on many airfields and that, although it is possible to fill the top layer of the trench with open macadam or turf and soil, loose stones are generally preferable from the point of view of drainage and especially in heavy clay soil such as that at Stansted. Mr. Struthers, deputy director of Works at the Air Ministry, stated that in the case of a drain of this sort settlement of two inches was to be anticipated. Mr. Cameron-Douglas, a senior investigating officer of the Accidents Investigation Branch at the Ministry of Transport & Civil Aviation, expressed the opinion that if the aircraft had met the drain at right angles while running straight it would have passed over it without damage. It is obvious that this drain was left somewhat over "proud" and that consideration must be given to the size of the stones used to fill it. Did these particular factors have any real effect on the incident in question?

Visit to Airport

In the course of the inquiry, I visited the airport and was able to inspect the track left by the aircraft as it ran off the runway and before it met the drain.

This large aircraft was swinging violently to starboard and the increasing width of the marks left by the tires and the rapid narrowing of the distance between these marks showed the intense skidding movement and are themselves eloquent witnesses of the tremendous lateral stresses put upon the undercarriage. I am satisfied that the dramatic increase in these stresses when the aircraft met the line of the drain, due to the scrubbing action to which the wheels were subjected, caused the undercarriage to collapse.

Evidence was put before me, which I accept, that any sudden change of surface might in these very unusual circumstances have produced a similar effect and indeed that if the aircraft had met a concrete taxiway instead of the loose stones of this drain the same results would have followed.

Ideally a runway should have on either side an expanse of grass large enough to ensure that an aircraft leaving the runway in any foreseeable circumstances will be able to run its course unimpeded by any obstacle. In practice this is impossible.

This drain was of a type which appears to me to be unobjectionable and in accordance with standard practice: it was properly sited and necessary and I do not think that the fact that some criticism may be made of the manner of filling made any real difference in this particular case, although I have thought it right to refer to this subject in making my recommendation at the conclusion of this report.

This aircraft left the runway in most unusual circumstances and I do not think that blame for what occurred can be put upon the drain. If this incident had occurred in wet weather and there had been no drain so that the ground was waterlogged a similar result would have occurred. If on this occasion it had swung to port instead of to starboard there were many obstacles, including the fire tenders which were to prove so valuable, with which it might have collided, as well as taxiways and hard standings which would have had a similar effect.

THE AIRCRAFT

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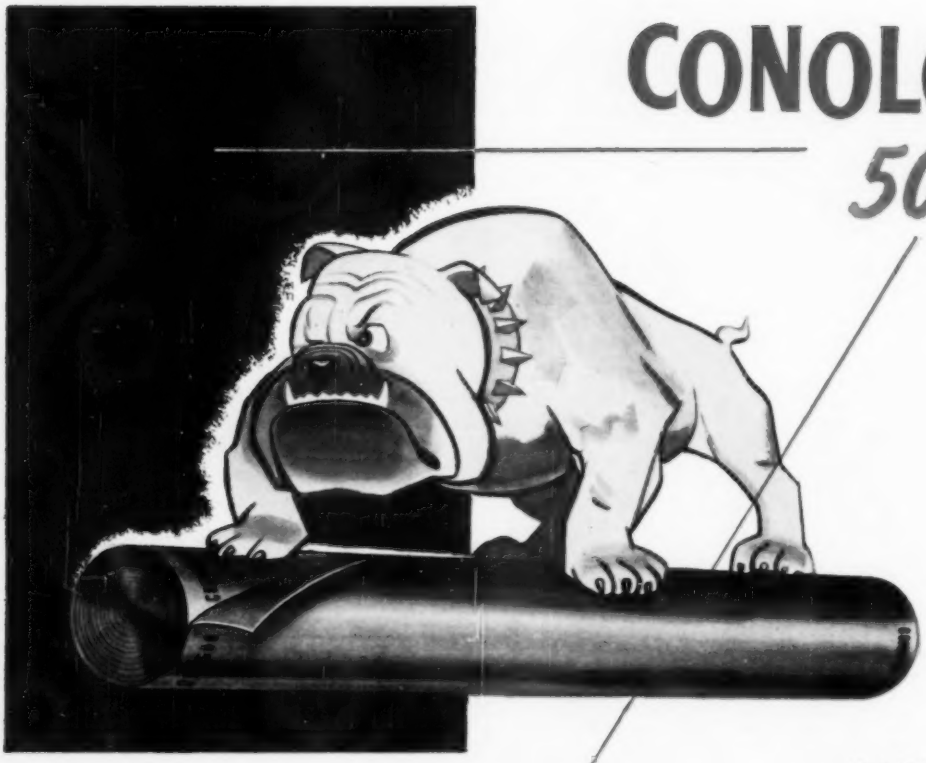

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had at the date of the accident flown 7,594 hr. in all. Prior to 1952 it flew 1,632 hr. with the Royal Air Force; purchased in that year by Scottish Airlines (Prestwick) Ltd., it was completely overhauled and reconditioned and since had flown 5,962 hours.

The current Certificate of Airworthiness was issued on June 20, 1955, valid until June 19, 1956. On the occasion of the issue of this certificate the undercarriage was removed en bloc, sent back to the makers and replaced by an undercarriage which had been brought up to the specification of a new unit.

Without attempting to detail the very considerable body of evidence put before me, I can summarize its effect in saying that there is no reason whatever to suggest that this accident was due to any mechanical failure or defect in the way in which this aircraft was constructed or maintained. I am satisfied that it was properly and efficiently maintained and entirely fit to carry passengers on the flight contemplated.

It had been properly loaded and trimmed, the brakes had been carefully tested and tests carried out after the accident served to prove that no engine failure or failure of controls occurred. The tires were in good condition and indeed, despite the stresses put upon them, retained their pressure.

The port wheel tire, which had been inflated to a pressure of 60 lb., held its pressure but stones of a size 1½ in. across were forced between the rim and the tire, a phenomenon which Mr. Cameron-Douglas had never seen before and which testifies to the extraordinary stresses involved. It is perhaps desirable to deal shortly with the fracture of the undercarriage.

An aircraft is not, of course, built to travel sideways any more than a motor car. The legs of the undercarriage were fractured at their top points of attachment. Calculations and inspection of the fractures made at the Royal Aircraft Establishment at Farnborough after the accident show that the stresses imposed on the undercarriage when it met the drain were increased to the order of three-four times those which it was already undergoing and to an extent which no undercarriage is designed to support.

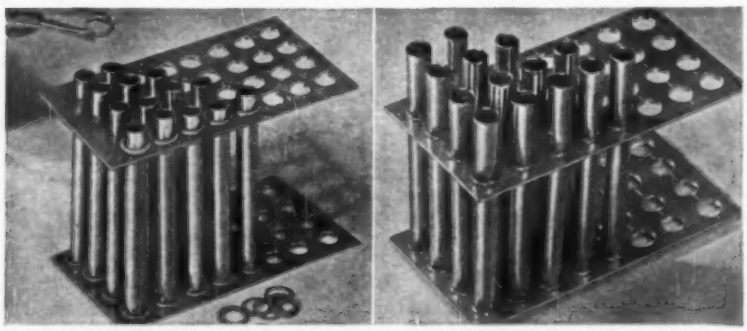
The fractures disclosed no sign of fatigue but on the contrary tensile strength very much above the specified minimum.

The evidence shows conclusively that this accident is not to be attributed to the aircraft.

HANDLING OF THE AIRCRAFT

Capt. Wilson, who was piloting "Uncle Love" when it crashed, is an experienced pilot. He has flown continuously without being involved in any accident since March, 1941, and on April 30 had flown a total of 10,477 hr., of which 1,178 hr. were in York aircraft. During 990 hr. of his experience in Yorks he had been in command. He was described by one witness, himself an experienced pilot, as "definitely an above-average pilot" and "a most experienced pilot who could be relied upon under all circumstances."

Another witness of similar qualifications said that his "ability was well up to what



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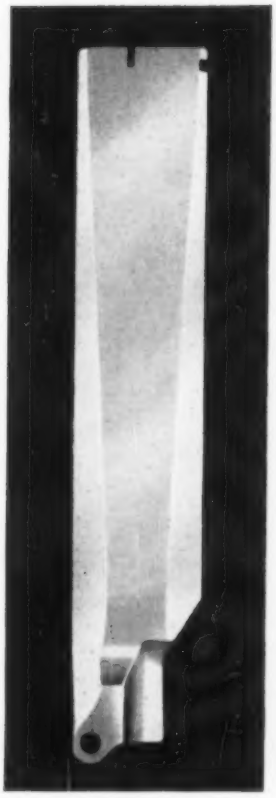

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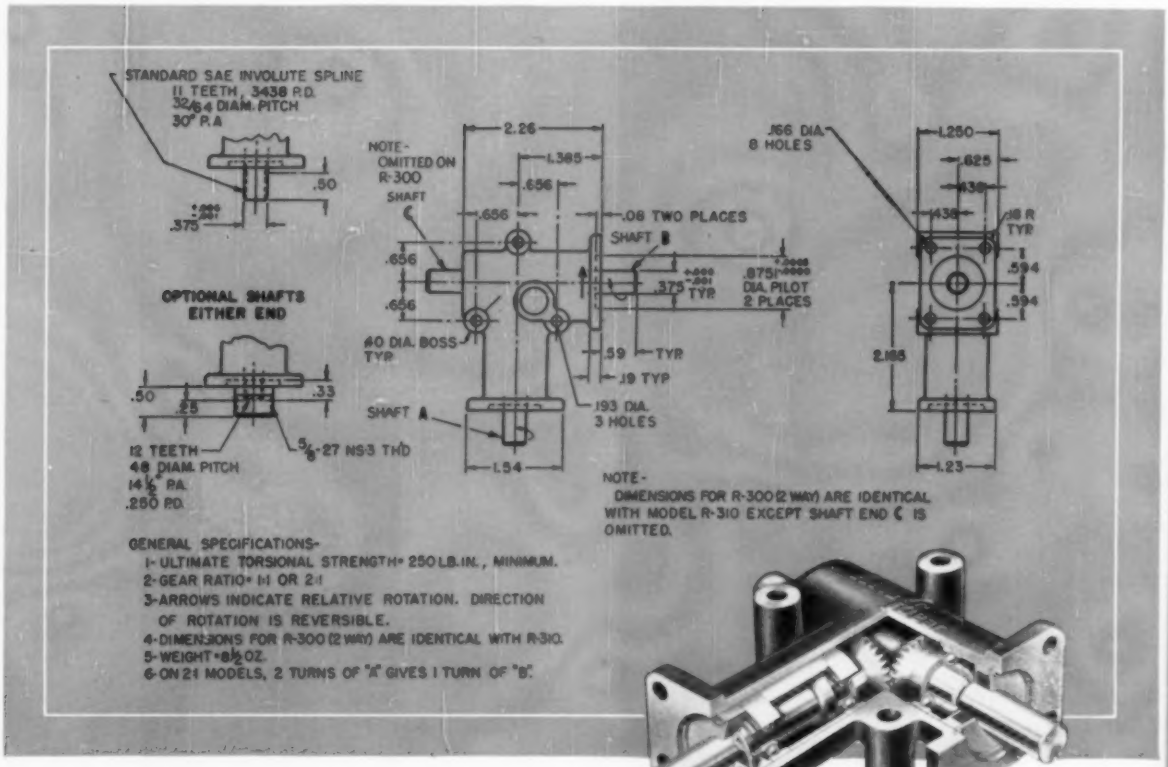

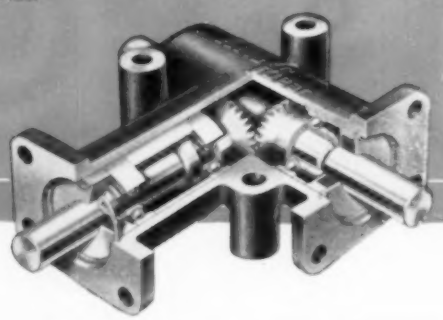

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R-320-2 2-way	2:1	1	1800	1500	⅝	2.2
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one would expect in view of his experience." Insofar as I could judge him as a witness in the circumstances of strain under which he gave evidence he appeared to be a careful and conscientious man who gave his evidence with commendable frankness.

On the morning in question Capt. Wilson reported to the airport for his flight, for which he had been warned 10-14 days before. A number of witnesses stated that he appeared entirely fit and he himself confirmed this. The passengers had been late in arriving at the airport and after they had been briefed and embarked and the necessary checks carried out it was shortly after 0930 GMT when "Uncle Love," after being taxied down to the runway, was lined up for its take-off run. Capt. Wilson was sitting in the first pilot's seat on the port side handling the aircraft, with First Officer Upperton in the second pilot's seat on his right.

A York aircraft in common with many aircraft has a tendency when rolling to pull to port. This tendency is of course well known to all experienced pilots and is not difficult to correct. The aircraft while on the ground can be controlled in three ways, firstly by the use of the throttles, secondly by the brakes which can be applied either to the port or starboard wheel or both and thirdly by the rudder which is operated with the feet.

• Throttles

There are four throttles (one for each engine) consisting of four levers projecting downwards from the throttle box, which is fixed rather above the first pilot's head and to his right front. It is to the left but otherwise in a similar relationship to the position of the second pilot.

The method of operating the throttles is for the pilot to grasp all four in his hand, inserting his fingers between the levers so that he can push these forward to open the throttles or pull back to close them, whilst by an inclination of his hand to one side or the other as he opens the throttles he can advance the port throttles ahead of the starboard or vice versa. In taking off there is normally no question of closing the throttles and the pilot is occupied in pushing them forward until he attains the desired speed—correcting his course by advancing one pair of throttles beyond the other as may be necessary.

To correct the York's tendency to roll portwards, it is generally necessary to advance the port throttles slightly in front of the starboard. The pilot, once he has got the aircraft rolling straight and at the desired speed, requires his right hand to join his left with which he has been holding the control column and accordingly the practice is for the second pilot to keep his left hand close behind the right hand of the pilot ready to take over the throttles when the pilot relinquishes them.

• Brakes

The handles operating these are fitted on either side of each control column, there being one provided for the pilot and another for the first officer. As stated the brakes can be operated equally or differentially. They are extremely powerful.

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Capt. Wilson's evidence was that he lined up "Uncle Love" on the threshold of the runway straddling the white line but pointing 5 deg. to the left of it. He had already run forward a yard or so to ensure that his tail wheel was straight. This evidence is corroborated and I am satisfied that the aircraft was properly lined up. It is not easy to line up a York exactly, and although in view of its tendency to travel to the left it is better to avoid any inclination in that direction, it canont be disputed that 5 deg. is well within the limits of tolerance. After carrying out the usual pre-take-off checks he received permission to takeoff and "Uncle Love" moved forward.

What happened thereafter is described by Capt. Wilson and his description in regard to the latter part of the aircraft's course can be checked with the track left by the wheels and subsequently plotted on a map. Capt. Wilson's account was as follows:

"It (that is "Uncle Love") moved slightly to the left. I corrected the take-off run. The aircraft seemed to come straight. Then I felt a violent swing to the right. I did not like it. I pulled everything (meaning the throttle levels) off and continued on. The aircraft seemed to roll fairly well. After I had got my hands off the throttles I was preparing to use control of the brakes to pull the aircraft up. The aircraft seemed to roll off. The next thing we were off in a 180 deg. turn. Then of course we sat down."

Closed Throttles

Capt. Wilson was insistent that he had not at any time used his brakes but thought that he might have used his rudder instinctively. When he closed the throttles he did so because he had decided to abandon the take-off run in view of the swing which had developed.

Asked what could have been the cause of the violent swing to starboard he said: "I cannot think of one myself. The only possible thing I could think of was that I must have somehow over-corrected. I would like the Court to tell me."

He added that he was "not conscious of having over-corrected" and that at the time he closed the throttles, which was before the aircraft crossed the center line, he thought his speed was "fast enough to cause trouble but not too fast to get out of it."

First Officer Upperton's account was that as "Uncle Love" left the threshold he had his head down watching the instruments. He said:

"I was aware we were moving to the left of the center line—it definitely was not a swing in any way but a slight movement to the left of the center line. The boost pressures were at this time +16 lb. each approximately. I put my left hand up by Capt. Wilson's right hand. I anticipated taking over from him and had my hand I think on the throttles and I felt him using differential throttle and still juggling with them and I looked up to see why. I saw that we were on the left-hand side of the runway—slightly on the left-hand side. I would not know how much but towards the

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left. The Captain pulled the throttles back and put his right hand on the control column. Almost immediately I pulled back No. 1 throttle—the port outer—because it was not fully closed."

He went on to describe the increasing severity of the swing and the outcome, and stated that the port outer throttle was "not as much as half open" when he himself closed it but more than would have been the case if it had merely bounced back a little on being closed. He was not conscious after putting up his left hand that Captain Wilson made any violent or abnormal movement of the throttles.

In addition to the evidence of Captain Wilson and First Officer Upperton I had evidence from other members of the crew and from various eye-witnesses. A body of evidence corroborated that of Captain Wilson and First Officer Upperton to the effect that the aircraft initially followed a normal course slightly to the left of the center line. Somewhere about the point where the tire marks were first charted, Capt. Wilson must have taken action to correct his course to port and bring the aircraft straight. Captain Wilson is not conscious that the correction he then made was other than a normal one and is convinced that he did not touch his brakes.

It was observed from the track of his tires that the initial tire mark is that of the starboard wheel and that at this point the width of the track is over 24 ft. and accordingly somewhat wider than the normal track width of 23 ft. 9 in.

Although the wheels are so set that they can float to a tolerance of some inches, the start of the track and the fact that the starboard wheel track is the first to appear are in my opinion important factors.

"Grave Error"

I cannot think in the light of the evidence that this swing could have developed without some grave error on the part of Capt. Wilson as indeed he himself now recognizes. This violent swing at so early a stage of the aircraft's run could only result from a correction of the portward course due either to a sudden and excessive differential use of the throttles or to a momentary application of brake to the starboard wheel or to both these factors. Capt. Wilson is not conscious that he did either of these things. I have no doubt that he over-corrected violently and excessively when he used the throttles to bring the aircraft straight and that this caused the beginning of the swing.

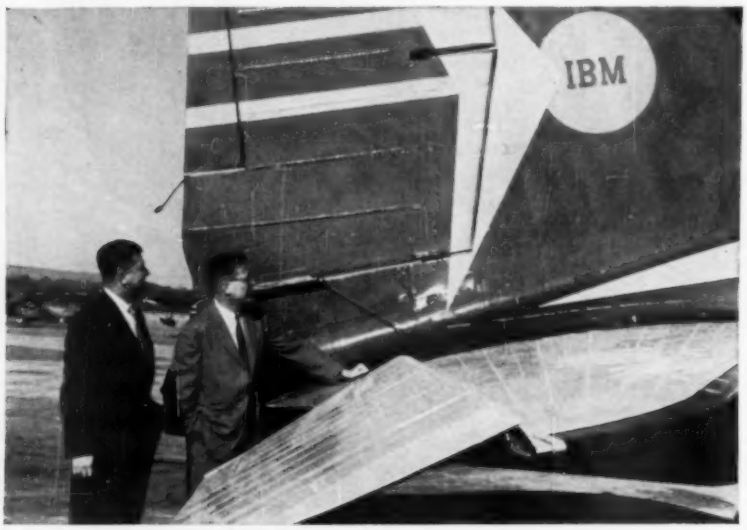
In the light of the starboard wheel mark and despite his belief to the contrary, I am inclined to think that he must at the same time have also applied the starboard brake. The latter supposition is necessarily speculative, but nothing else will in my opinion account for the sudden development of so severe a swing that even before he crossed the center line he decided to close all throttles and to abandon the take-off. The fact that in closing the throttles he left the port outer open would, since it had been at 16+ boost, serve to accentuate the swing but the effect of this error was quickly corrected by First Officer Upperton.

It is difficult without experiencing the violence of the swing as Capt. Wilson did to attempt to judge whether his decision to close the throttles and to abandon the take-off was the right decision. Equally, it is not easy to criticize what he did or failed to do after he had closed the throttles. In the latter stages of the swing use of the rudder would hardly have influenced his course and experienced pilots who gave evidence expressed the opinion that it was better at this stage not to use the brakes.

In these circumstances I am not prepared to condemn Captain Wilson's decision to close the throttles or his subsequent failure to control the course of the aircraft. The vital error was committed earlier when he started to correct his portward course.

My answers to the questions asked by H. M. Attorney-General are accordingly:

- **Question 1.** Did the aircraft have a valid Certificate of Airworthiness and did it have a current Certificate of Maintenance at the commencement of the flight?
- **Answer 1.** Yes.
- **Question 2.** What was the cause of the accident?
- **Answer 2.** An over-correction of the portward course of the aircraft possibly accompanied by some application of the starboard brake, causing the aircraft to swing to starboard off the runway and to encounter the French drain with the resulting failure of the undercarriage.
- **Question 3.** Was the accident caused or attributed to by the wrongful act or default of any person or party?
- **Answer 3.** In my opinion the over-correction by the pilot whether or not accompanied by some application of the



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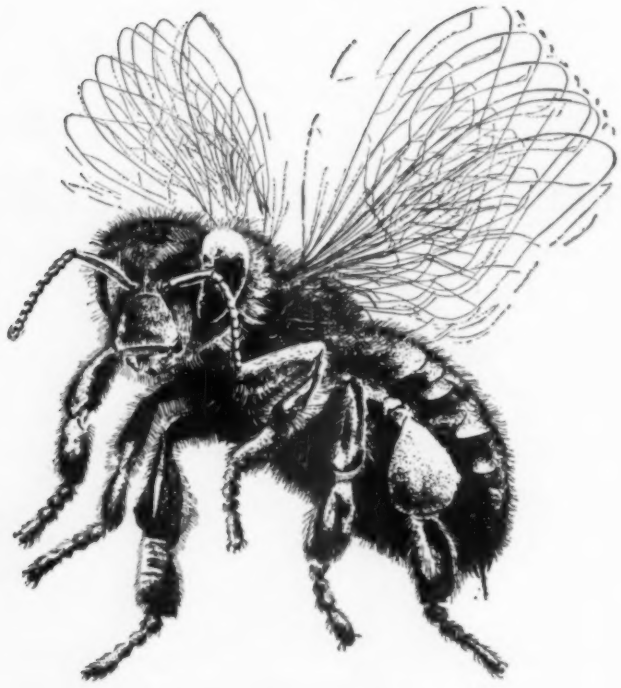

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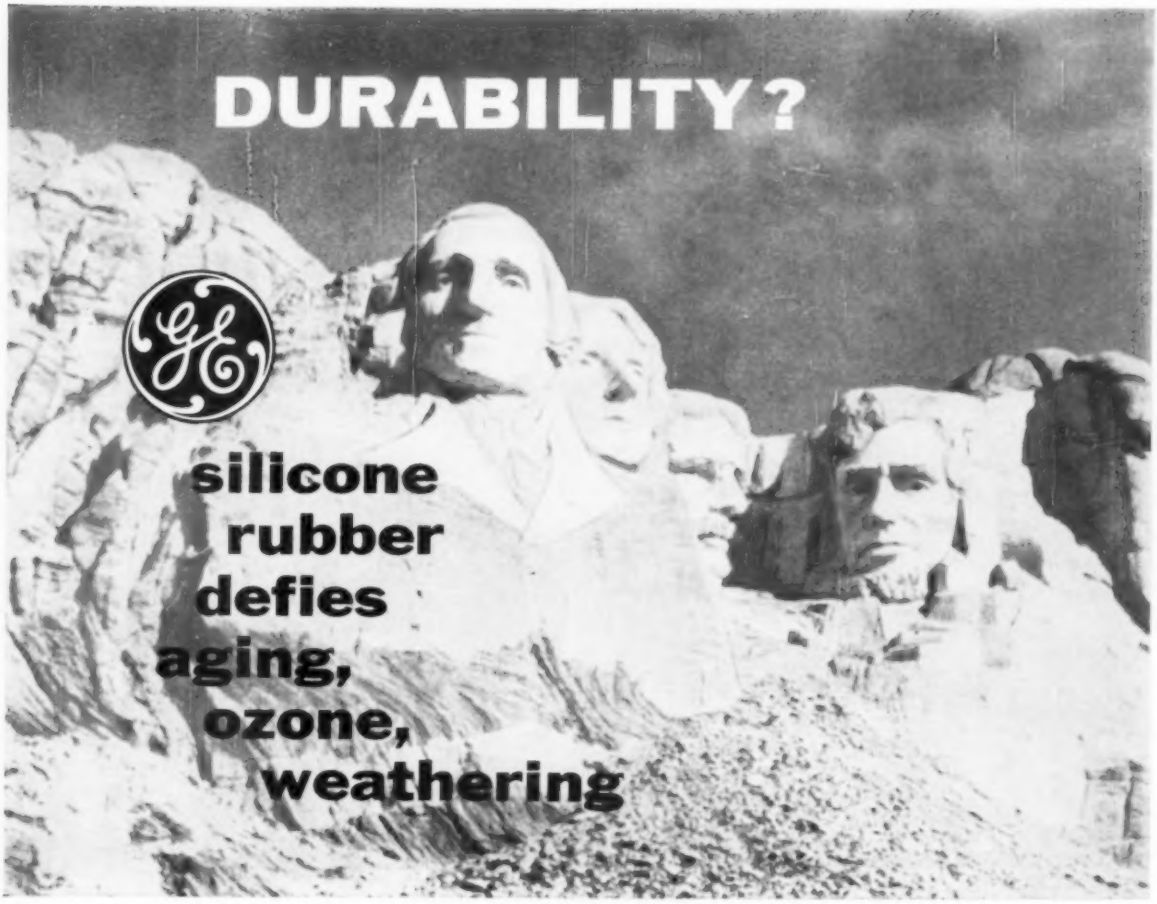

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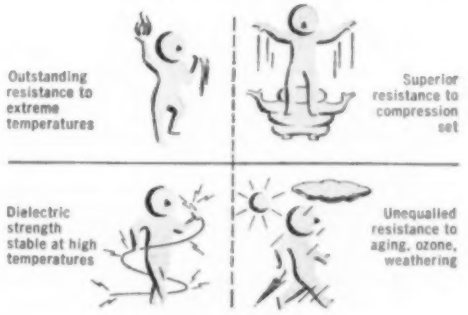
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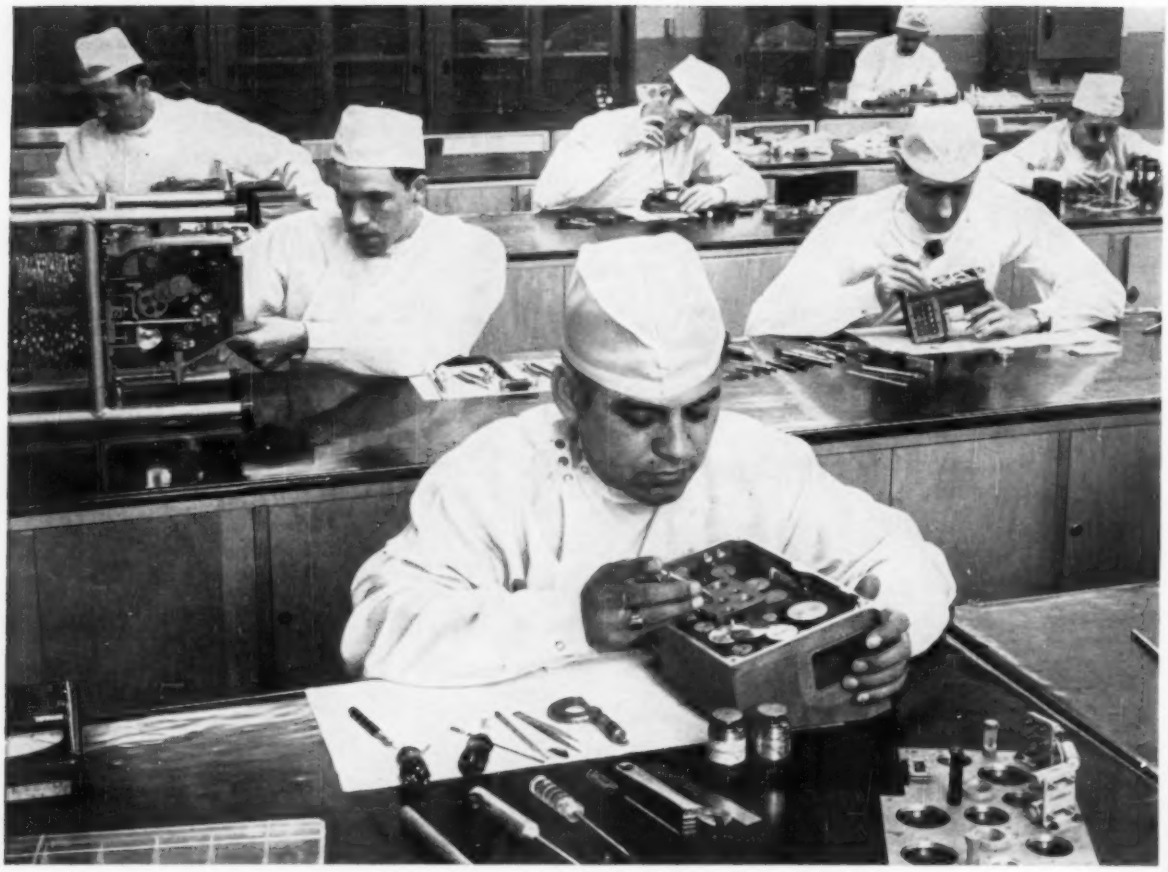

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starboard brake should be termed a grave error of judgment and skill rather than a wrongful act or default.

SAFETY BELTS

Mrs. Howley, the mother of the little girl of 4 who was killed and who was herself pinned by the entry of the port wheel gave evidence. She described the briefing given before embarkation and proceeded to give her account of what happened after she entered the aircraft. The seats in "Uncle Love" all faced backwards and she with her two children, one aged 2 and other 4, were accommodated in the fifth row reading from the nose of the plane. She herself sat on the starboard side next to the window with her daughter, 2 years old, next to her. The elder child, the girl who was killed, sat the other side of the gangway with an aircraftman sitting on her right in the seat next to the port window.

She described how an airman sitting behind her fastened the safety straps for herself and her youngest child while the aircraftman sitting next to the elder child fastened hers for her. She stated: "We could not tighten the lap straps and the air hostess did not come and bend over my two daughters and check theirs. They were miles too big for them and they were not tight enough for them."

She went on to say that there were remarks from the airmen behind her that the safety straps should have been checked and later suggested that the elder child, Sheila, who was killed, was thrown out of her seat on the impact and before the wheel came through the fuselage.

In considering this evidence it must be remembered that Mrs. Howley had a terrible experience. I thought it necessary none the less to examine this allegation with some care. I saw the type of safety strap used and I am satisfied that this is a type which is extremely easy to adjust and is readily capable of adjustment so that the space contained would enable it to be brought tight around the lap even of a very small child.

The air hostess, who gave evidence, described how she walked up and down checking the safety straps visually at least three times before taking up her seat for the take-off. Mrs. Howley did not dispute that she had done so and admitted that she did not ask the air hostess for advice or assistance. She had not done so "because it was her duty to do it without being asked to do it." Finally I had the evidence of some of the rescue workers, who described how Sheila was found pinned against the roof of the cabin in the manner I have described, still in her seat with safety strap around her.

I am satisfied that there is no ground for Mrs. Howley's complaint. She did not appear to realise exactly what had happened to Sheila and thought, from what she says she was told, that the child had been thrown right out of her seat, whereas in fact nothing of the sort occurred. I have no doubt that her memory is somewhat clouded by the shock which she must herself have sustained and I think that dwelling upon this inaccurate belief she has come to the conclusion that the child could only have been thrown if the safety belt had not been properly adjusted and ac-

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cordingly has concluded that such was the case.

Mrs. Howley was herself in the Womens Auxiliary Air Force for 12 years and is a woman who I am quite sure would have had no hesitation in asking for assistance if she had required it. Equally I am confident that the airman sitting behind her and her small daughter who adjusted their belts and the aircraftman who adjusted Sheila's would have asked for assistance had there been any difficulty at the time.

Finally the evidence of those who found Sheila's body after the accident proves conclusively that her belt was properly adjusted, that she was not thrown from her seat and that there is no true basis for this complaint.

Although the terms of my appointment may not strictly require it, the evidence in regard to the action of the airport staff who averted fire and the rescue work undertaken by them and by employes of Scottish Airlines disclosed skill, courage and initiative of a high order and such as I think deserves to be recorded. In the first place I would mention the prompt action of the air traffic control officer, Mr. Haycock, who had pressed the alarm bell even before the aircraft left the runway. Secondly, I think it right to refer to the conduct of the members of the Airport Fire Brigade, led by Section Leader Beardall. These men, in accordance with their standing instructions, are alerted for the take-off of any four-engined aircraft carrying passengers. They were in their vehicles as "Uncle Love" started its run and Section Leader Beardall described how, in accordance with their drill, engines were started and the vehicles turned as the aircraft made its run in order to keep it immediately in sight over the bonnet. Their adherence to this drill and their instructions enabled these vehicles to proceed without any delay whatever to the scene of the incident and to lay the layer of foam and thereby avert fire. . . .

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I would recommend that in the case of this particular drain steps should be taken to reduce the extent to which it is over "proud" to at most two inches and to substitute for the top layer of stones at present in position smaller stones less likely to cause damage. I suggest that since this method of filling is apparently employed at other airfields, all necessary steps should be taken to check the top layer in these cases also. H. J. PHILLIMORE

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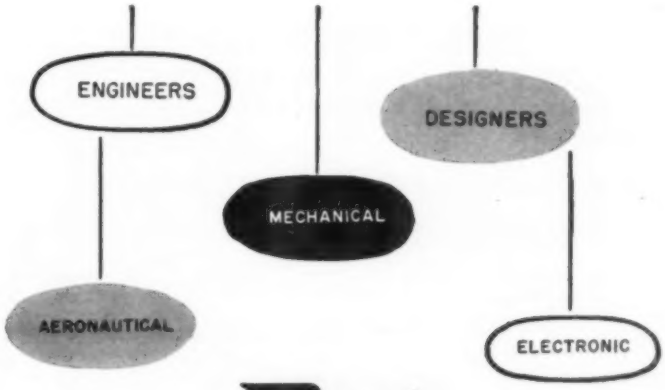

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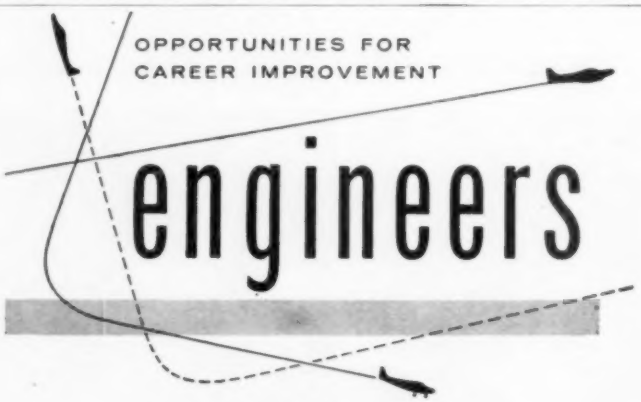

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Aircraft Gas Turbine Division

GENERAL ELECTRIC
Cincinnati 15, Ohio

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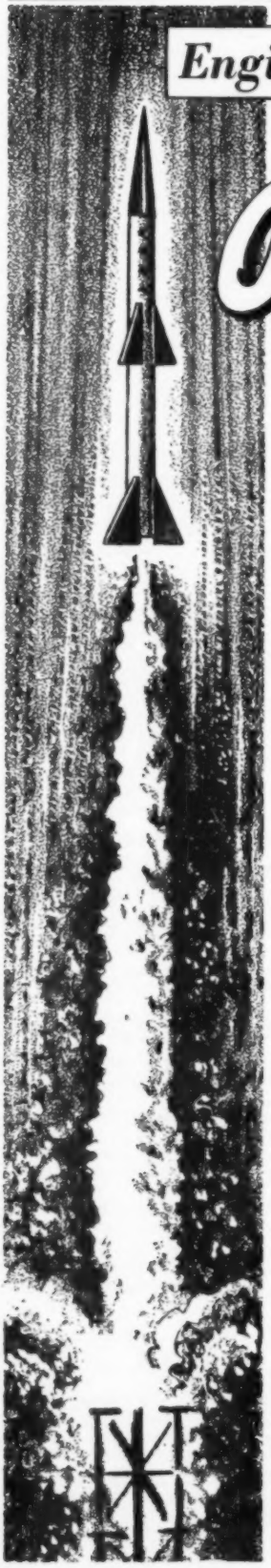

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P-2970, Aviation Week
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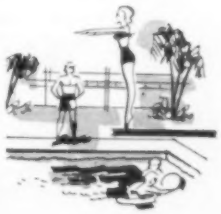

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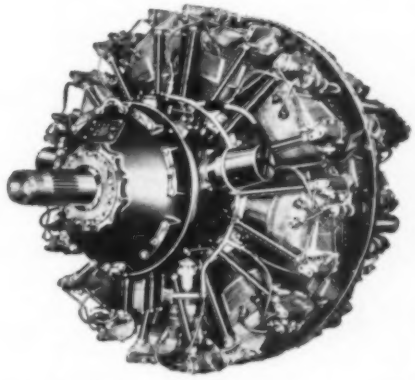

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LETTERS

Company Omitted

Your August 6 issue of AVIATION WEEK contains a very interesting and complete coverage of the Air Research and Development Command.

I can appreciate the editorial problems in collecting and editing all the information from the various test facilities, and I think you have done an excellent job. I realize it is important on an undertaking of this type to obtain complete and accurate information from all of the test bases. However, we were very disappointed in your coverage of Edwards Air Force Base in which you devoted an entire paragraph to their Data Processing System being developed under Project Datum without mentioning that the Electronic Engineering Company of California is the prime contractor of the development of the entire project.

Your article mentioned various sub-contractors who have participated in the project and have made valuable contributions. The Electronic Engineering Co. has the overall responsibility for the design, installation and evaluation of the system, and has developed a number of major system components in addition to those listed in your article.

We feel that the Air Force personnel at Edwards Air Force Base responsible for the initiation of this development are to be congratulated for their foresight in having organized this important project.

Although there are other automatic or semi-automatic processing systems at other government facilities, we believe that the system at Edwards Air Force Base, when completed and in full operation, will represent one of the most integrated and advanced systems to date.

R. B. BONNEY, Vice President
Electronic Engineering Company of Calif.
Los Angeles, Calif.

Job Change Reply

The letter written by Fred C. Stebbins (AW Aug. 20, p. 114) was very interesting to me, and as I am probably one of that group of engineers of which he was speaking, I should like to pose a few questions for Mr. Stebbins' consideration. I am assuming we are not speaking of an inexperienced engineer just out of college since Mr. Stebbins states that the engineers he refers to have ". . . job after job listed of a year or two duration, each successive job paying a $1,000 or so more. . . ."

The first question that comes to my mind is whether Mr. Stebbins feels that there is something unusual about the work of his company that requires a minimum two year break-in period whereas other companies would not require such an extensive period of familiarization. From the tone of his letter I would assume he does not feel his company has any corner on this problem.

On this assumption, I then wonder why a company which has an engineer in its employ who has completed this period of indoctrination and is ready to carry his own weight can not afford to pay this engineer a better salary than would a second company which presumably must also provide a similar training period of two years before it will realize its investment.

Thirdly, I would like to know how Mr. Stebbins formed his conviction that a good engineer will require two years indoctrination before he carries his own weight.

It is my own feeling that this conviction is at the root of much of the dissatisfaction among engineers today. This conviction seems to be shared by many employers and supervisors, though the fancied length of indoctrination required may vary from one person or company to the next. Naturally, some familiarization is necessary, but I think that in most cases it is far less than imagined by those who make the job assignments.

Finally, is a company being fair to itself or its newly-hired engineers, if it pays him more than he is worth to the company in order to entice him away from some other employment? An engineer who has been hired at an increase in salary doesn't expect to wait for two years before he is given responsibility of the same scope as he had in the job he left. He expects, after a reasonable period of familiarization, to be given responsibilities commensurate with his salary and experience.

Furthermore, it would not seem unreasonable for him to expect to continue to receive assignments of increased responsibility (and compensation) as his experience grows and he becomes more valuable to the company.

I don't pretend to be a personnel expert, but somehow the idea that an engineer must remain for several years at substantially the same salary as that at which he was hired in order that the company may regain the training investment does not seem to be a particularly sound policy. The training investment line of reasoning sometimes begins to seem like a convenient way to fend off a raise rather than a bona fide explanation of company policy.

CLARK B. STEWART
Rockville, Md.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Engineer's Advice

Just finished reading the several letters on p. 146 of your July 16th issue and would like to add the following.

First, would like to point out that I did not read the article "Douglas Engineer" (AW June 11, p. 146)—however, from reading the mentioned letters, this article must have concerned salary and advancement in position.

As it happens, the firm I am employed by has been trying several years to hire one or two engineers. These attempts have been made by applying to several engineering schools and through ads in the papers. Briefly, this firm I work for is rather small—employing about 100 people. A line of sheet metal fabricating tools and machinery is manufactured. This firm has been in business 46 years.

I find that when mention is made that the firm is small and not one with a glamorous name, these new engineers being graduated lose complete interest. Further, these young people just being graduated seem to feel they fall in the $6,000 to $10,000 salary bracket. They are interested too in what benefits the company may offer. That takes care of new graduates.

Now those answering news ads are mostly undesirables or failures who want from $15,000 to $25,000.

There are thousands of small firms just like ours all in need of engineering aid. However, they cannot compete with huge government supported firms and many will "die on the vine" due to the lack of this engineering aid.

It is my belief that there is more opportunity for advancement and also greater chance of better paying positions with these small firms than there ever will be with these huge governmental supported organizations.

Further, it would be better if these engineers and so-called engineers take stock of themselves and come down to earth with their salary demands—the "honeymoon" definitely will be over soon.

JERALD D. JENSEN
Whitney Metal Tool Co.
Rockford, Ill.

'Crash Boondoggle'

The editorial, "Congress Leaves Sorry Safety Record" was excellent (AW Aug. 13, p. 21).

The names of the nine Congressmen who participated in the Las Vegas boondoggle to "investigate" the Grand Canyon accident should be printed to provide a reference list for voters in the coming elections.

K. H. WOLVINGTON
General Electric Co.
Johnson City, N. Y.

Battled for Progress

Congratulations on your editorial, "We Are All to Blame," in the current issue of AVIATION WEEK.

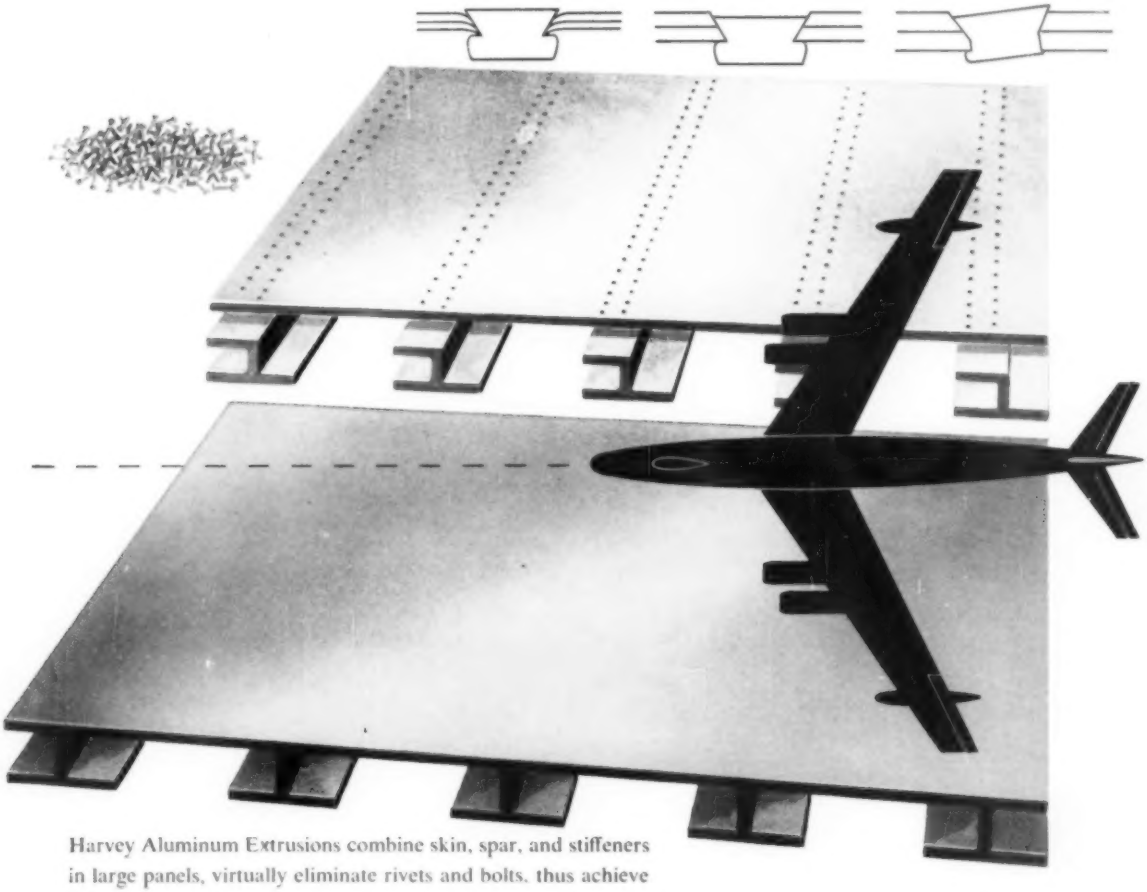
This Air Space Control situation was one of the projects which Fred Lee was most interested in. He battled vigorously for progressive measures to combat new dangers—until he was removed.

It is deplorable that his vast experience and good judgment cannot be utilized somewhere in the present circumstances to expedite plans for remedying the critical situation.

MERRILL C. MEIGS
The Hearst Corporation
Chicago 6, Illinois

Harvey extrusions... simpler, smoother parts for better flight

Improperly installed rivets and bolts have always contributed heavily to the turbulence and drag that downgrade a plane's over-all performance. On light-gage skins, dimples result . . . on medium skins, rivets can be countersunk, but often end up below the desired surface . . ; the steel bolts used on heavy skins just can't be shaved to surface smoothness.



Harvey Aluminum Extrusions combine skin, spar, and stiffeners in large panels, virtually eliminate rivets and bolts, thus achieve a degree of aerodynamic smoothness that reduces operating costs and improves performance. And at the same time, assembly is faster, sealing is eliminated, and inspection is simplified.

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HARVEY Aluminum

Harvey is a leading independent producer of aluminum extrusions in all alloys and all sizes, special extrusions, press forgings, hollow sections, structurals, rod and bar, forging stock, pipe, tube, impact extrusions, aluminum screw machine products and related products. Also similar products in alloy steel and titanium on application.

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U. S. AIR FORCE TRANSPORT IN PRODUCTION

Allison Turbo-Prop powered Lockheed C-130 Hercules can outfly present passenger airliners while airlifting up to 20 tons of cargo

POWERED BY FOUR 3,750-horsepower Allison T56 Turbo-Prop engines, driving three-bladed Aeroproducts turbo-propellers, the Lockheed C-130 Hercules attains top speeds of over 370 miles per hour. And it operates at less than half the ton-mile cost of its nearest competitor.

More than 100 miles an hour faster than tactical transports flying today, the C-130 on combat missions, with 25,800 pounds of cargo and more than 5,000 gallons of fuel, can cross the continent, or an ocean, nonstop at 330 miles per hour cruise speed.

Thus, the U. S. can put supply lines in the sky – with ability to airlift cargo, personnel and equipment from the continental U. S. to a distant overseas air base and reach a combat area shortly following the arrival of jet aircraft.

With full load, the C-130 takes off and climbs to 2,500 feet in 60 seconds – a remarkable feat for a large transport. The Hercules has a flexible flight envelope in that it has the ability to fly at low altitudes for airdrops of personnel and equipment and yet has a high-altitude range of 40,000 feet.

Product of a 5-year joint effort by the Air Force, Allison and Lockheed Aircraft, the C-130 is being produced in quantity by Lockheed's Marietta, Ga., plant. These high-performance Turbo-Prop transports will begin joining the Tactical Air Command late this year.

ALLISON DIVISION OF GENERAL MOTORS, Indianapolis, Indiana

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